THE

BOTANICAL GAZETTE

EDITORS

JOHN M. COULTER, Wabash College Crawfordsville, Ind
CHARLES R BARNES, University of Wisconsin, Madison, Wis
J C ARTHUR, Purdue University, Lafayette, Ind

VOLUME XVI

1891
CRAWFORDSVILLE, INDIANA
PUBLISHED BY THE EDITORS

PRESS OF
TRACY, GIBBS & COMPANY,
MADISON, WIS

TABLE OF CONTENTS.

BRIEFER ARTICLES—

EDITORIAL—

OPEN LETTERS—

CURRENT LITERATURE—

NOTES AND NEWS—

BOTANICAL GAZETTE

VOL. XVI.— CRAWFORDSVILLE, IND., JANUARY, 1891. —NO. 1

Undescribed plants from Guatemala. VIII.

JOHN DONNELL SMITH.

(WITH PLATES I AND II.)

Prof. Alfred Cogniaux, Dr. M. T. Masters and Dr. W. O. Focke, distinguished monographers of orders, have contributed to this paper descriptions of new species detected by them among the plants submitted to them respectively for determination.

Bocconia vulcanica.—Branchlets, foliage and panicle smooth and shining; leaves glaucous beneath, obovate-elliptical (5–6 x 2½ in.), acute apex long-mucronate, tapering below to broadly sessile base, margin evenly glandulo-mucronate with rounded indentations: bracts foliaceous, bractlets scarious: sepals oval (6 x 3½ lines), exceeding pedicels, recurved-cuspidate: 10–15 stamens a third shorter, filaments half as long as linear anthers: stout style prolonged from ovary, a half shorter than stigmas: capsule (immature) elliptic-oblong, twice exceeding stipe.—*B. integrifolia* Humb. et Bonpl., likewise arborescent and with lobeless leaves crowded about base of large drooping panicle, is distinct by indument, long-petiolate leaves entire or nearly so, stamens equaling calyx, subsessile anthers.—Slopes of Volcan de Agua, Dept. Zacatepequez, alt. 10,000 feet, April, 1890, J. D. S. (Ex Pl. Guat. qu. edid. J. D. S. 2172.)

Chorisia soluta.—Calyx shortly pedunculate, 3-bracteolate, ligneous, cupulate-campanulate (20 lines long), aureolanate within, irregularly 5-lobed: petals distinct, linear-spatulate (5–6 in. x 10 lines), apex emarginate, sericeo-tomentose and fuscous without, glabrate and red within: stamens three-fourths as long; column short (10 lines), annulate at apex;

exterior lobes one-fifth as long, ovate, entire, hirsute; interior branches 10–12, filiform, 2-antheriferous, anthers long and anfractuose: ovary free, imperfectly 5-celled, ovules pyriform.—A tree with the gigantic trunk and flat widespreading head of *Bombax Ceiba* L., and with digitate leaves. The incomplete character is drawn from the only parts within reach of the collector—freshly fallen flowers. The staminal column partite to annulus into doubled number of branches is exceptional for the genus.—Shores of Lake Amatitlan, Dept. Amatitlan, alt. 3,900 feet, Feb., 1890, J. D. S. (Ex Pl. cit. 1924.)

Myrodia Guatemalteca.—Leaves elliptical or obovate-elliptical (8–10×3–4 in.), abruptly acuminate, obtuse base 3-nerved, veins pubescent, axils barbate: flowers solitary or geminate, axillary and extra-axillary, approximated: calyx twice longer than deflexed minutely 3-bracteolate pedicel, sericeous within, 5–6 unequal lobes ovate (2–3 lines): petals tomentulose, elliptic-oblong (1 in.), shortly unguiculate, half-exsert: staminal column shorter, its 5 lobes regularly 4-antheriferous: cells of ovary 2, 2-ovulate, style pentagonal, stigma bilobed: immature fruit ovoid (5 lines).—*M. funebris* Benth., *ex descr.* nearly related, differs by lanceolate leaves, subsessile solitary flowers, erose calyx equalling claws of petals and twice exceeded by 25–30-antheriferous staminal column.—Pansamalá forest, Dept. Alta Verapaz, alt. 4,000 feet, Jan., 1889, v. Türckheim (Ex Pl. cit. 1410): April, 1889, J. D. S. (Ex Pl. cit. 1634.)

Heteropteris retusa.—Leaves short-obovate (20–24×15–18 lines), each end obtuse, apex retuse and cuspidate, sparsely pilose, veins rufo-pubescent and uni-glandular above base of lowest pair; petiole terete, bi-glandular at or below apex: panicles rufo-tomentulose, 2–3-fasciculate from axils of reduced upper leaves and terminal, umbellately compound, sub-equalling leaves; pedicels 3–5, bracteolate in middle, exceeding flowers: sepals minute: petals twice longer (2 lines), oblong, base rounded, carinate, shortly unguiculate, crimson; the interior broader with stout claw and denticulate: filaments exceeding calyx, anthers oblong, connective incrassate: styles a little shorter.—Near *H. cotinifolia* Ad. Juss., but with different leaves and glands, solitary panicles, smaller flowers, etc.—Erect shrub 8–12 feet high with brachiate lenticellate branches, along streams near Escuintla, Dept. Escuintla, alt. 1,100 feet, March, 1890, J. D. S. (Ex Pl. cit. 2068.)

RUBUS OCCIDENTALIS L., var. **grandiflora** Focke.—Differt a planta typica floribus fere duplo majoribus post anthesin nutantibus.—Slopes of Volcan de Aqua, alt. 8,500 feet,* April, 1890, J. D. S. (Ex Pl. cit. 2168.)

Potentilla Donnell-Smithii Focke.—Caudiculi e radice multicipite breves lignosi stipulis annorum præcedentium scariosis vestiti. Caules prostrati digitales pubescentes, apice ascendentes ramosi pauciflori. Folia inferiora petiolata imparipinnata trijuga vel bijuga, foliolis approximatis, *infimis majoribus manifeste petiolulatis*, aliis lateralibus subsessilibus. Foliola inæquilatera sub-ovata inciso-serrata, serraturis confertis obtusis, utrinque appresse pilosa. Folia superiora ternata breviter petiolata, foliolis illis foliorum inferiorum similibus. Stipulæ vaginantes petiolo adnatæ, inferiores scariosæ, supremæ magna ex parte liberæ ovatæ dente uno alterove præditæ. *Flores breviter pedunculati*, pedunculo diametrum floris fere æquante, folia vix superante. *Bracteolæ calycinæ* sepalis fere æquilongæ *trilobæ* (vel inciso-tridentatæ) ; sepala late ovata, interdum dente uno alterove prædita. Petala obovata sepalis longiora lutea. Styli subterminales basi incrassati. Torus hirsutus.—Planta alpina humilis. Habitu ad *P. dissectam* Pursh, *P. Richardii* Lehm. et *P. Ehrenbergianam* Schldl. accedit, sed et ab his et ab omnibus aliis speciebus Americanis distinguitur bracteolis calycinis trilobis.—Bottom of crater of extinct Volcan de Agua, alt. 12,000 feet, April, 1890, J. D. S. (Ex Pl. cit. 2144.)

AGRIMONIA PARVIFLORA Ait.? var. **macrocarpa** Focke.—Differt a planta typica fructibus majoribus, foliolis paucioribus et brevioribus.—The determination is provisional. In many cases it is very difficult to trace the limits between the closely allied species of *Agrimonia*. The Guatemala specimen agrees in essential points with the *A. parviflora* of the United States. Its fruits are much larger, but show the same shape and the same direction of spines. The leaflets are less numerous and nearly as narrow, but shorter. These differences are not very important, and therefore I prefer at present to consider the plant as a variety. A more complete acquaintance, however, will perhaps disclose distinctive marks of greater importance. (Focke).—Coban, Dept. Alta Verapaz, alt. 4,300 feet, Feb., 1889, v. Türckheim. (Ex Pl. cit. 1409.)

Tibouchina Bourgaeana Cogn. (§ DISTANTHERA); ramis setis arcte adpressis basi tuberculatis subsparse armatis; foliis mollibus, anguste lanceolatis, longiuscule acuminatis, basi satis attenuatis, subtiliter serrulatis, utrinque adpresse pilosis, 5-nerviis, nervis lateralibus basi longiuscule coalitis; cymis plurifloris; calycis tubo ovoideo, lobis subulatis, tubo brevioribus; staminibus omnine glabris, subaequalibus; antheris brevibus, oblongis, apice obtusis, connectivo basi brevissime producto. Rami graciles, erecti. Petiolus 0.5–1.5cm. longus. Folia 4–8cm. longa, 8–17mm. lata. Calycis tubus 2.5mm. longus; lobi 1.5–2mm. longi. Petala lilacina, ciliata, apice setoso-apiculata, 4–5mm. longa. Antherae 1.5mm. longae. Stylus 4mm. longus.—Yzabal, Dept. Yzabal, alt. 100 feet, April, 1889, J. D. S. (Ex Pl. cit. 1514).

Monochaetum diffusum Cogn. (§ EUMONOCHAETUM); ramis junioribus pilis patulis simplicibus eglandulosis densiuscule longeque hirtellis; foliis longiuscule petiolatis, membranaceis, oblongo-lanceolatis, acutiusculis, triplinerviis, subadpresse sparseque setulosis praecipue subtus ad nervos; cymis diffusis, plurifloris; calyce pilis patulis glandulosis sparse hirtello, lobis tubum aequantibus.—Rami graciles, obscure tetragoni, fuscescentes, satis ramulosi, diffusi. Petiolus filiformis, 4–8mm. longus. Folia supra laete viridia, subtus pallida, 3–5cm. longa, 1–1.5cm. lata. Flores rosei, longe graciliterque pedicellati. Calycis tubus cinereus, campanulatus, 4–5mm. longus; lobi patuli, triangulari-lineares, 4–5mm. longi. Petala obovata, apiculata, 6–7mm. longa. Antherae majores arcuatae, 4mm. longae, cauda paulo incrassata elongata sursum revoluta; minores subrectae, 3mm. longae, cauda subfiliformi adscendente.—Pinula, Dept. Guatemala, alt. 4400 feet, Feb., 1890, J. D. S. (Ex Pl. cit. 2217).

Conostegia hirtella Cogn.; ramis junioribus petiolisque setulosis; foliis oblongo-lanceolatis, basi acutis vel acutiusculis, apice longiuscule acuminatis, integerrimis vel vix undulato-denticulatis, 5-plinerviis, supra sparsissime setulosis, subtus ad nervos leviter hirtellis et vix furfuraceis caeteris glabratis; alabastris anguste obovoideis, acutiusculis, vix furfuraceis.—Rami satis graciles, obscure tetragoni, juniores densiuscule et breviuscule hirtelli. Petiolus supra densiuscule breviterque hirtellus caeteris breviter furfuraceus, 1–2.5 cm. longus. Folia membranacea, paulo disparia, 13–19 cm. longa, 4–5.5 cm. lata. Paniculae furfuraceo-hirtellae, sub-

multiflorae, fere 1 dm. longae; flores 5-meri, distincte pedicellati. Alabastra 6 mm. longa, 3.5 mm. crassa. Petala late obovata, profunde emarginate, 5–6 mm. longa. Antherae oblongo-lineares, 2.5 mm. longae. Stylus crassiusculus, 3 mm. longus, stigmate obtuso.—Pansamalá forest, alt. 3,800 feet, May 1887, v. Türckheim. (Ex Pl. cit. 1233.) Distributed as *C. lasiopoda* Benth.?

Miconia Guatemalensis Cogn. (§ OCTOMERIS); foliis breviuscule petiolatis, membranaceis, ovatis, breviter acuminatis, basi rotundatis vel vix emarginatis, integerrimis vel minutissime denticulatis et setulis brevissimis patulis densiuscule ciliatis, 5-nerviis, supra sparse setulosis, subtus ad nervos leviter furfuraceis caeteris brevissime subsparseque stellato-puberulis; paniculis laxiusculis, submultifloris; floribus 5-meris; calyce leviter furfuraceo, lobis brevissimis, late rotundatis.—Frutex ramis robustiusculis junioribus petiolis paniculisque brevissime et densiuscule stellato-pub erulis. Petiolus 1–4 cm. longus. Folia 6–9 cm. longa, 3. 5–5 cm. lata. Paniculae 4–8 cm. longae; pedicelli saepius vix 1 mm. longi. Calycis tubus suburceolatus, 2 mm. longus; lobi vix 1 mm. longi. Petala ut videtur rubra, 3 mm. longa. Stylus 4 mm. longus.—Tamahu, Dept. Alta Verapaz, alt. 5,000 feet, July 1887, v. Türckheim. (Ex Pl. cit. 924, 1317.)

Miconia Tuerckheimii Cogn. (§ OCTOMERIS); ramis junioribus petolis paniculis foliisque subtus brevissime denseque stellato-tomentosis; foliis anguste ovatis, breviter acuminatis, minute denticulatis, 7-nerviis, supra brevissime denseque villoso-hirtellis; floribus 4-meris, pedicellatis; calyce stellato-tomentoso et sparse glanduloso-piloso.— Petiolus 3–8cm. longus. Folia submembranacea, basi rotundata, 2–2.5dm. longa, 12–14 cm. lata. Paniculae 2.5 dm. longae; pedicelli glandulosi, 1–3 mm. longi. Calyx 3 mm. longus, breviter lobatus. Petala 3 mm. longa.—Coban, alt. 4,800 feet., Mch. 1881, v. Türckheim (Ex Pl. cit. 581).

Clidcma laxiflora Walp., var. *β.* **longipetiolata** Cogn.—Rami petioli pedunculique longiore pilosi. Petiolus 5–7 cm. longus. Folia profundiore inaequaliter serrulata. Calyx longe denseque hirsutus.—Pansamalá, alt. 3,800 feet, June 1885, v. Türckheim (Ex Pl. cit. 707). Distributed as typical.

Clidemia Donnell-Smithii Cogn. (§ SAGRAEA); ramis junioribus petiolisque pilis patulis elongatis pallide fulvis

dense vestitis; foliis submembranaceis, longiuscule petiolatis, oblongis vel ovato-oblongis, subintegerrimis, longiuscule acuminatis, basi rotundatis, 7-nerviis, supra breviter sparseque setulosis, subtus densiuscule longeque pilosis; cymis parvis, paucifloris; pedicellis longiusculis, minute bibracteolatis; calyce densiuscule longeque hirtello, dentibus exterioribus subulatis, tubum aequantibus.—Rami robustiusculi, teretes, simplices. Petiolus robustiusculus, 2–6 cm. longus. Folia saepius satis disparia, supra intense viridia, subtus viridi-cinerea, 10–18 cm. longa, 4.5–7.5 cm. lata. Cymae patulae, 2–3 cm. longae; pedicelli filiformes, 6–8 mm. longi; bracteolae subulatae, 1 mm. longae. Calycis tubus campanulatus, 3 mm. longus; dentes exteriores erecto-patuli, flexuosi, 2.5–3 mm. longi. Petala rubra, obovata, apice rotundata, 4–5 mm. longa. Antherae oblongo-lineares, 1.5 mm. longae. Stylus capillaris, 5–7 mm. longus, stigmate punctiformi.—Pansamalá, alt. 3,800 feet, July, 1888, v. Türckheim. (Ex Pl. cit. 1433.)

JUSSIÆA PERUVIANA L., var. **glaberrima.**—Absolutely smooth throughout: peduncle and calyx nitidous: sepals mucronate and denticulate: flowers 2 in. in diameter: stamens 8, oblong anthers equalling filaments: capsule elongated.—Shrub 12 ft. high, swamp near Dueñas, Dept. Zacatepequez, alt. 5,000 ft., Apr. 1890, J. D. S. (Ex Pl. cit. 2130.)

JUSSIÆA PILOSA H. B. K., var. **robustior.**—Densely branched shrub, 6–8 ft. high, angulate with decurrent petioles and branches: leaves crowded, small, fleshy, scabrid, sprinkled with red glands, margin rubescent: bracts minute, subulate, gland-stipellate: flowers 6-merous, sepals splitting in fruit to 7–9: seeds of one of the cells often biseriate.—Swamp on Lake Antonio near Dueñas, alt. 5,000 ft., Apr. 1890, J. D. S. (Ex Pl. cit. 2123.)

Passiflora (§ CIEGA) **clypeophylla** Mast.—Glabra, ramis complanatis sulcato-striatis; petiolis 20–30 mm. longis medio glandulis duabus majusculis sessilibus munitis; stipulis herbaceis lineari-subfalcatis acutis; laminis circa 6 cm. long. 10 cm. lat. glabris submembranaceis peltatis 5-nerviis subrotundis vel obscure trilobis margine incrassato albido angusto circumdato; pedunculis petiolos subaequantibus simplicibus supra medium articulatis; bracteis caducis minutis; floribus diametro 10–12 mm. tubo brevi campanulato intus

plicato; sepalis oblongis glabris; corona fauciali biseriata filamentosa, filis externis sepala subaequantibus basi purpureis apicem versus luteis, filis intimis lineari-clavatis truncatis procedentibus tertia parte brevioribus; corona media membrancea longitudinaliter plicata purpurea margine in dentes acutos inflexos margine eversos divisa, corona infra mediana annulari; gynophoro glabro; ovario globoso glabro.—Barranca del Rubelcruz, Dept. Alta Verapaz, alt. 2,500 ft., April, 1889, J. D. S. (Ex Pl. cit. 1625.)

Passiflora (§ DECALOBA) **allantophylla** Mast.—Setulosa, ramis herbaceis compressis sulcato-striatis; petiolis 15 mm. eglandulosis; stipulis lineari-subulatis; laminis circa 20 mm. long. 40–50 mm. lat. membranaceis glabris subtus sparse ocellatis palmatim 3-nerviis basi late cordatis vel subrotundatis, ad medium bilobatis, lobis divergentibus rotundatis nervo excurrente mucronulatis; lobulo intermedio subobsolete truncato sinu latissimo; pedunculis geminis petiolos aequantibus vel superantibus simplicibus vel superne cymoso-tribrachiatis; bracteis setaceis caducis; floribus 10–12 mm. diam., tubo brevi patelliformi basi intruso extus intusque glabro; sepalis herbaceis oblongis obtusis; petalis hyalinis albidis sepalis parum brevioribus; corona fauciali 1-seriata filamentosa, filis ligulatis flavidis basi purpurascentibus quam petala parum brevioribus; corona mediana membranacea tubulata apice in lobos acutos inflexos fimbriatulos ad margines eversos divisa; coronâ infra mediana carnosula anguste annulari; corona basilari praecedenti conformi; gynophoro glabro; ovario subgloboso glabro.—Santa Rosa, alt. 5,000 feet, Sept. 1888, v. Türckheim (Ex Pl. cit. 1425.)

Passiflora (§ DECALOBA) **transversa** Mast.—Glabrescens vel subhirtella; ramis complanatis sulcato-striatis; petiolis 2 cm. long. eglandulosis; stipulis subulatis herbaceis; laminis 4 cm. long. 12–13 cm. lat. subcoriaceis glabris transversim ellipticis, 3-nerviis, basi ocellatis, apice mucronulatis nonnunquam excisis; pedunculis petiolis dimidio brevioribus puberulis bracteis setaceis munitis. Floribus diametro 35 mm. tubo patulo brevi extus puberulo intus glabro; sepalis herbaceis oblongo-obtusis; petalis sepalis parum brevioribus albidis; corona fauciali filamentosa biseriali, filis extimis liguliformibus flavis petalis paulo brevioribus, filis intimis fere dimidio brevioribus; corona media membranacea tubulata superne in dentibus puberulis inflexis divisa; corona basilari carnosula

annulari; gynophoro glabro pentago; filamentis gracilibus; ovario oblongo glabro.—Masaqua, Dept. Escuintla, alt. 400 feet, April, 1890, J. D. S. (Ex Pl. cit. 2099.)

Passiflora (§ DECALOBA) **ornithoura** Mast.—Glabra; ramis compressis sulcato-striatis; stipulis lineari-subulatis caducis; petiolis circa 25mm. long. eglandulosis; laminis 10cm. long. 5 cm. lat. membranaceis subtus sparse ocellatis basi cuneatis vel subrotundatis, palmatim 3-nerviis infra medium bilobatis, lobis late divergentibus lanceolatis, secus nervum medianum fascia albida angusta notatis, lobo intermedio deltoideo subobsoleto; pedunculis geminis simplicibus petiolos aequantibus; bracteis minimis filiformibus acutis; floribus diametri 2cm.; tubo brevi patelliformi extus puberulo intus nitido; sepalis herbaceis oblongo-obtusis; petalis hyalinis albidis sepalis tertia parte brevioribus; corona fauciali 1-seriata e filis crassis clavatis petalis dimidio brevioribus constante; corona mediana membranacea tubulata longitudinaliter plicata margine lobata lobis lanceolatis inflexis marginibus eversis fimbriatulis; corona basilari annulari carnosula; gynophoro tereti glabro; ovario globoso glabro; fructu globoso magnitudine cerasi parvi purpureo; seminibus albidis transverse sulcatis, striisque longitudinalibus notatis.—Dueñas, alt. 5,000 feet, April, 1890, J. D. S. (Ex Pl. cit. 2136.)

Passiflora (§ DECALOBA) **dicthophylla** Mast.—Glabra, ramis compressis striatis; petiolis circa 25 mm. eglandulosis; stipulis lineari-subulatis; laminis 5–6 cm. long. 4–5 cm. lat. membranaceis sparse ocellatis vel eglandulosis basi subcuneatis vel subrotundatis palmatim 3-nerviis, infra medium 2-lobatis, lobis divergentibus oblongis obtusiusculis, mucronulatis, sinu lunatim exciso lobulo intermedio obsoleto; pedunculis geminis petiolos aequantibus vel superantibus simplicibus; bracteis setaceis minutis munitis; floribus diametro 15 mm., tubo brevi late campanulato; sepalis herbaceis oblongis obtusis; petalis albidis sepalis dimidio brevioribus; corona fauciali filamentosa, filis uniseriatis lineari-clavatis petalis fere dimidio-breviorbus; corona media membranacea late tubulata plicata margine profunde dentata, dentibus fimbriatulis; corona infra mediana annulari crassa; gynophoro glabro; ovario globoso nitido; fructu magnitudine cerasi globoso glabro purpureo; seminibus compressis apice productis tranversim annulato striisque verticalibus notatis.—Dueñas, alt. 5,000 feet, April 1890, J. D. S. (Ex Pl. cit. 2143).

Melothria Donnell-Smithii Cogn. (§ EUMELOTHRIA); monoica; foliis membranaceis, ovatis vel ambitu suborbicularibus, utrinque punctato-scabris, integris vel usque ad medium 3–5-lobatis, lobis apice saepius rotundatis terminali interdum acuto; cirrhis simplicibus; racemis masculis saepius 3–5-floris, petiolo brevioribus; petalis leviter emarginatis; antheris subquadratis, loculis paulo arcuatis, connectivo lato; floribus femineis longe pedunculatis, fructu majusculo, triloculari, concolore; seminibus immarginatis.—Rami graciles, elongati, glabri vel vix pilosuli, laeves, alternatim albo et viridi longitudinaliter striati. Petiolus satis gracilis, brevissime subsparseque hirtellus vel glabratus, 2–5 cm. longus. Folia ovata, integra vel saepius paulo lobata, apice acuta, 6–8 cm. longa, 5–7 cm. lata, supra intense viridia, subtus paulo pallidiora et ad nervos interdum brevissime hirtella, margine minute remoteque denticulata; sinus basilaris saepius angustus, 1–1.5 cm. profundus. Cirrhi graciles, sulcati, glabri. Pedunculus communis masculus gracilis, puberulus, 1.5–3 cm. longus, apice 2–15-florus; pedicelli 3–10 mm. longi. Calyx campanulatus, basi obtusus, glaber, 3 mm. longus, minute denticulatus. Corolla tenuissime furfuracea, fere 1 cm. lata, segmentis patulis. Antherae ciliatae, 1 mm. longae. Flores feminei solitarii. Pedunculus fructiferus filiformis, 2–6 cm. longus. Fructus ovoideus, 3.5–4 cm. longus, 2.5 cm. crassus. Semina pallida, ovata, 3.5–4 mm. longa, 2–2.5 mm. lata. Species *M. scabrae* Naud. (Cogn. in DC. Monogr. Phan. III, 582) proxima.—Masagua, alt. 400 feet, April, 1890, J. D. S. (Ex Pl. cit. 2203).

Var. *β.* **hirtella** Cogn.—Rami sparse hirtelli. Petiolus densiuscule hirtellus, 3–7 cm. longus. Folia ambitu late ovata, plus minusve lobata, apice saepius obtusa.—Escuintla, alt. 1100 feet, March, 1890, J. D. S. (Ex Pl. cit. 2206).

Var. *γ.* **rotundifolia** Cogn. Rami petiolique ut in typo. Folia ambitu suborbicularia, saepius satis profunde 5-lobata, lobis apice rotundatis.—San Luis, Dept. Escuintla, alt. 1,000 feet, Mch. 1890, J. D. S. (Ex Pl. cit. 2,208).

Anguria oblongifolia Cogn.; tota glaberrima; foliis breviter petiolatis, integris, oblongis, vix acuminatis, basi acutis, regulariter penninervis; floribus parvis, sessilibus, ad apicem pedunculi communis capitatis; antheris rectis, oblongis, tubo calycis paulo brevioribus, appendice vix perspicua leviter papillosa coronatis.—Rami graciles, laeves, simplices, elongati, striati. Petiolus gracilis, 2–3 cm. longus. Folia tenuiter

membranacea, laete viridia, utrinque laevia, margine integerrima vel vix undulata, 10–13 cm. longa, 5–6 cm. lata; nervi tenues, subtus vix prominentes. Cirrhi graciles, longiusculi, tenuiter striati. Pedunculus communis masculus gracilis, 2.5 dm. longus, apice 8–10-florus. Calycis tubus anguste oblongus, basi rotundatus superne satis constrictus, teretiusculus, 8 mm. longus; dentes lanceolato-lineares, erecto-patuli, 1 mm. longi. Petala suborbicularia, uninervia, extus tenuiter furfuracea, 3 mm. longa. Antherae 5 mm. longae, 1.5 mm. latae. Flores feminei et fructus ignoti. Species *A. longipedunculatæ* Cogn. (Monogr. Phan. III, 673) proxima.—Rio Dulce, Dept. Livingston, sea level, Mch. 1889, J. D. S. (Ex Pl. cit. 1510).

Anguria diversifolia Cogn. (§ V. ANTHERAE MUTICAE); tota glaberrima; foliis breviter petiolatis, simplicibus, trinerviis, modo integris vel vix trilobatis anguste ovatis acutis basi oblique subtruncatis, modo fere usque ad basim tripartitis segmentis lanceolatis breviter acuminatis inferne contrictis; floribus parvis, sessilibus, ad apicem pedunculi communis breviter spicatis subcapitatis; antheris oblongis, rectis, muticis.—Rami satis graciles, laeves, sulcati, paulo ramulosi. Petiolus gracilis, 1–2.5 cm. longus. Folia membranacea, laete viridia, utrinque laevia, margine integerrima, 8–14 cm. longi; nervi crassiusculi, subtus leviter prominentes. Cirrhi crassiusculi, elongati, inferne sulcati. Pedunculus communis masculus robustiusculus, sulcatus, 2–3.5 dm. longus, apice 10–25-florus. Calycis tubus anguste oblongus, basi subacutus, superne valde constrictus, teretiusculus, 10–11 mm. longus; dentes lineares, erecto-patuli, 2 mm. longi. Petala obovata, extus dense furfuracea, 5–6 mm. longa. Antherae 4–5 mm. longae, 1.5 latae. Flores feminei et fructus ignoti.—Pansamalá, alt. 3,800 feet, November, 1888, v. Türckheim (Ex Pl. cit. 1414.)

Gurania Donnell-Smithii Cogn.; foliis ambitu suborbicularis, basi profunde emarginatis, usque ultra medium trilobatis, lobis anguste ovatis, abrupte longiuscule angusteque acuminatis; calycis tubo breviusculo, ovoideo, tomentoso-cinereo, segmentis subulatis, uninerviis, rubrocinereis, utrinque densiuscule breviterque puberulis, tubo duplo longioribus; antheris late-oblongis, inferne replicatis, connectivo lato, apice appendiculato.—Rami robusti, sulcati, densiusculi et breviuscule hirtelli. Petiolus robustus, striatus, longiuscule

denseque villosus, 8–10 cm. longus. Folia membranacea, utrinque breviuscule sparseque pilosa praecipue subtus ad nervos, supra intense viridia, subtus satis pallidiora, margine remote spinuloso-denticulata, 2.5 dm. longa lataque; lobi exteriores paulo breviores, terminalis basi satis constrictus; nervi röbusti, utrinque paulo prominentes, duo laterales basilares trifurcati, imum sinum marginantes; sinus basilaris 5 cm. profundus. Cirrhi robusti, sulcati, breviusculi villosi. Pedunculus communis masculus robustus, striatus, densiuscule breviterque villosus, 3.5–4 dm. longus, apice 30–40-florus; flores subsessiles. Calycis tubus 8–10 mm. longus, 6–7 mm. latus; lobi erecti, 1.5–2 cm. longi. Petala conniventia, linearia, acutiuscula, extus furfuracea, 6–7 mm. longa, vix 1 mm. lata. Antherae 5 mm. longae, 2 mm. latae, connectivo glabro, apice in appendicem papillosam 1 mm. longam producto. Flores feminei et fructus ignoti. Species *G. Levyanae* Cogn. (l. c. 686) proxima.—Rio Chactá, Dept. Alta Verapaz. alt. 2.500 feet, April 1889, J. D. S. (Ex Pl. cit. 1511.)

Sicyos longisepalus Cogn. (§ EUSICYOS); foliis longiuscule petiolatis, ambitu cordato-ovatis, angulato 5-lobatis, utrinque punctato-scabris, lobis triangularibus, nervis lateralibus imum sinum non marginantibus; cirrhis bifidis; racemis masculis simplicibus, 8–20-floris, folio longioribus; calycis dentibus elongatis; pedunculis femineis apice 3–4-floris; fructu ovoideo, satis compresso, acuto vel obtusiusculo, vix puberulo et setis elongatis persistentibus subsparse vestito.—Rami graciles, sulcati, subglabri. Petiolus robustiusculus, striatus, brevissime puberulus, 3–7 cm. longus. Folia tenuiter membranacea, intense viridia, margine remote vix denticulata, 8–12 cm. longa, 7–10 cm. lata, lobis lateralibus brevibus, acutiusculis, terminali majore, acutissimo; nervi vix prominentes, supra vix puberuli; sinus basilaris acutus, 1–3 cm. profundus. Cirrhi robustiusculi, elongati, striati, glabrati. Pedunculus communis masculus gracilis, striatus, brevissime puberulus, 1–2.5dm. longus, superne vel fere usque ad medium floriferus; pedicelli filiformes, demum reflexi, 5–10 mm. longi. Calycis tubus subrotatus, vix puberulus, 5 mm. latus; dentes patuli, lineari-subulati, 4 mm. longi. Corolla spureo-alba, vix puberula, segmentis patulis, late ovato-triangularibus, obtusiusculis, 5–7 nerviis, 4 mm. longis. Pedunculus fructiferus 3 cm. longus. Fructus basi rotundatus, 8–10 mm. longus; setae 3–6 mm. longae. Species

S. Deppei G. Don (Cogn. l. c. 876) proxima.—Antigua, Dept. Zacatepequez, alt. 5,000 feet, April, 1890, J. D. S. (Ex Pl. cit. 2202.)

Cephaelis glomerulata (§ CEPHAELIDEÆ Muell. Arg. in Fl. Brasil.)—Dichotomous, glabrous: stipules solitary, triangular-truncate, apex fimbriate: leaves oval-lanceolate ($4–5 \times 1\frac{1}{2}–2$ in.), acuminate, base acute, patent secondary nerves about 14 uniting in marginal arches: heads of bracteose glomerules subsessile, semi-globose (9 lines high, 1 in. broad); bracts coriaceous, pallid, margin virescent or violaceous, the 6–8 exterior oblate-roundish, of glomerules obovate passing into shorter spatulate membranaceous conduplicate bractlets: calyx scarious ($1\frac{1}{2}$ line), two-thirds free, unequally subulate-toothed: corolla white, half-exsert from bractlet, slender (6 lines), one-fourth-lobed, upper half cano-pubescent within: anthers (2 lines) exceeding filaments: bi-lobed disk equalling ovary; drupe ovoid (3 lines), sulcate, blue.—Shrub 3–4 ft. high with habit and leaves of *C. dichotoma* Rudge and *Psychotria Martiana* Muell. Arg., but differing from both by developed bractlets of glomerules and of flowers.—Swampy woods on Rio Dulce, sea-level, Mch. 1889, J. D. S. (Ex Pl. cit. 1637).

EXPLANATION OF PLATE I —Fig 1, flowering branch Fig 2, head with all but one of the bracts removed Fig 3, glomerule Fig 4, exterior bract Fig 5, exterior bractlet. Fig 6, interior bractlet. Fig. 7, stipule Fig. 8, flower Fig. 9, corolla of long-styled flower laid open. Fig. 10, vertical section of short-styled flower with corolla removed Fig 11, drupe (Figs 1 and 2 are natural size; the others are variously magnified.)

LOBELIA LAXIFLORA H. B. K., VAR. **insignis**.—Glabrous in every part: stem simple, stout, 3–4 ft. high: leaves densely confert, linear-lanceolate (7×1 in.), sessile, glandular teeth appressed: peduncles bractless, nearly equalling leaves: flowers 2 in. long: calyx-segments one-fifth as long, linear, twice exceeding tube: corolla carinately nerved; tube half as broad as long, yellow varied with red; divisions of upper lip red on both sides; lower lip plicate, half as broad as long, yellow margined with red.—Mr. Hemsley refers to the type a plant collected by Salvin in similar locality. The congested large leaves and flowers impart a distinct habit.—Slopes of Volcan de Agua, alt. 10,000 feet, April, 1890, J. D. S. (Ex Pl. cit. 2173.)

MACLEANIA CORDATA Lemaire, var. **linearifolia**.—Leaves obscurely penninerved, above conspicuously reticulated, linear-lanceolate ($4–5 \times \frac{1}{2}–\frac{3}{4}$ in.), regularly tapering from

rounded base to acute mucronulate apex.—Pansamalá forest, alt. 4,000 feet, July 1887, v. Türckheim (Ex Pl. cit. 1332.)

ARCTOSTAPHYLOS PUNGENS H. B. K., *(not Gray)*, var. **cratericola.**— Younger parts and racemes puberulous: branchlets trigonal from stout short (1 line) petioles: leaves crowded, smooth and shining, punctate beneath, oval or obovate (6–7 x 4–5 lines), each end obtuse, apex callose: capituliform racemes scarcely equalling leaves, 4–6-flowered, coloured bracts exceeding abbreviated pedicels: filaments circularly dilated at middle, chiefly beardless; anthers nearly half as long, equalling short smooth awns: style exceeding stamens.—Tufted, with prostrate branches a foot or more long, on rocks in the crater of Volcan de Agua, alt. 12,000 feet, April 1890, J. D. S. (Ex Pl. cit. 2159.)

SOLANUM OLIVÆFORME, Botan. Gazette, XIV. 28, XV. 28.

EXPLANATION OF PLATE II.—Fig 1, portion of a plant in flower. Fig 2, portion of a plant in fruit Fig. 3, vertical section of flower Fig. 4, stamen. Fig. 5, pistil. Fig 6, transverse section of fruit. Figs 1 and 2 are natural size, the others are variously enlarged.

Daphnopsis Tuerckheimiana (§ NORDMANNIA Benth. et Hook.)—Epiphytal (?), dichotomous: petioles short, incrassate; leaves coriaceous, glabrous, ovate-lanceolate or lanceolate (3–5 in.), caudately produced, base acute, margin revolute, veins immersed: umbelliform staminate fascicles lateral and terminal, subsessile, bracteate, pilose, 5–7-flowered, pedicels short: perianth 5–6-times longer (3½–4 lines), clavate, smooth within, lobes one-fifth as long with alternate ones the broader: superior stamens partly exsert, interior inserted above middle of tube: abortive ovary hirsute, globose, equalling style, ovule manifest; stipe long as pistil (½ line); scales as long, united in cylindrical dentate sheath splitting variously: fertile flowers not seen.—Inflorescence apparently similar to that of a recent Brazilian species, *D. Sellowiana* Taubert, Bot. Jahrb. XII, Beibl. 7, which seems incorrectly referred to the section NEIVIRA Griseb.—Pansamalá forest, alt. 3,800 feet, Sept. 1886, v. Türckheim. (Ex Pl. cit. 1039.)

MYRIOCARPA LONGIPES Liebm., var. **Yzabalensis.**—Leaves round-oval, abruptly cuspidate, petioles from a third to nearly as long and like veins strigillose: branches of pistillate inflorescence 2–3, twice dichotomous, flowers sessile: achenia black and shining, scabrid with sparse short hairs: stigma

conspicuous.—Shrub 6–8 ft. high, Monte Cachirulo, Dept. Yzabal, alt. 900 ft., Apr. 1890, J. D. S. (Ex Pl. cit. 1644).

Triuris brevistylis.—About 3 in. high, aphyllous: inflorescence uniparous, twice furcate, peduncles ½–1 in. long, semi-amplexicaul bracts with rounded lobes at base: perianth-segments with twice longer appendages 3–4 lines long: styles pubescent, sub-terminal, capillary, deflexed, shorter than obtuse carpels of ovary; stigma oblique; fruit obovate, puberulous.—*T. diaphana* Miers, one-third as large, with cauline leaves, sheathing entire bracts, less developed inflorescence, is distinguished best by carpels elongated into terminal subulate styles.—On decayed trunks of trees, Pansamalá forest, alt. 3,800 feet, Sept. 1888, v. Türckheim (Ex Pl. cit. 1384).

NEPHRODIUM DUALE, described as new, BOT. GAZ., XV. 29, must be referred to *Aspidium ascendens* Hew., which in view of the distinctly reniform involucre of the present specimens may be better designated as *Nephrodium ascendens.* It has been known hitherto only from Jamaica.

Baltimore, Md.

On certain new or peculiar North American Hyphomycetes. I.

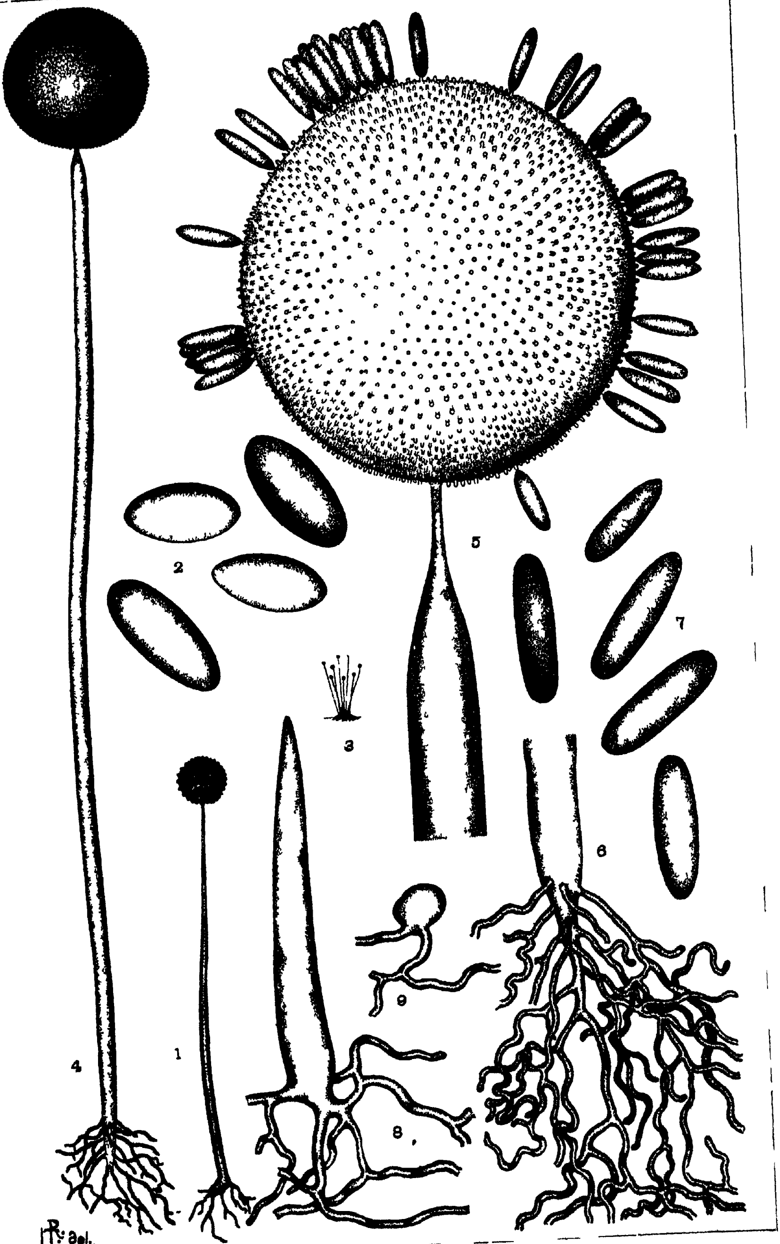
Oedocephalum, Rhopalomyces and Sigmoideomyces n. g.

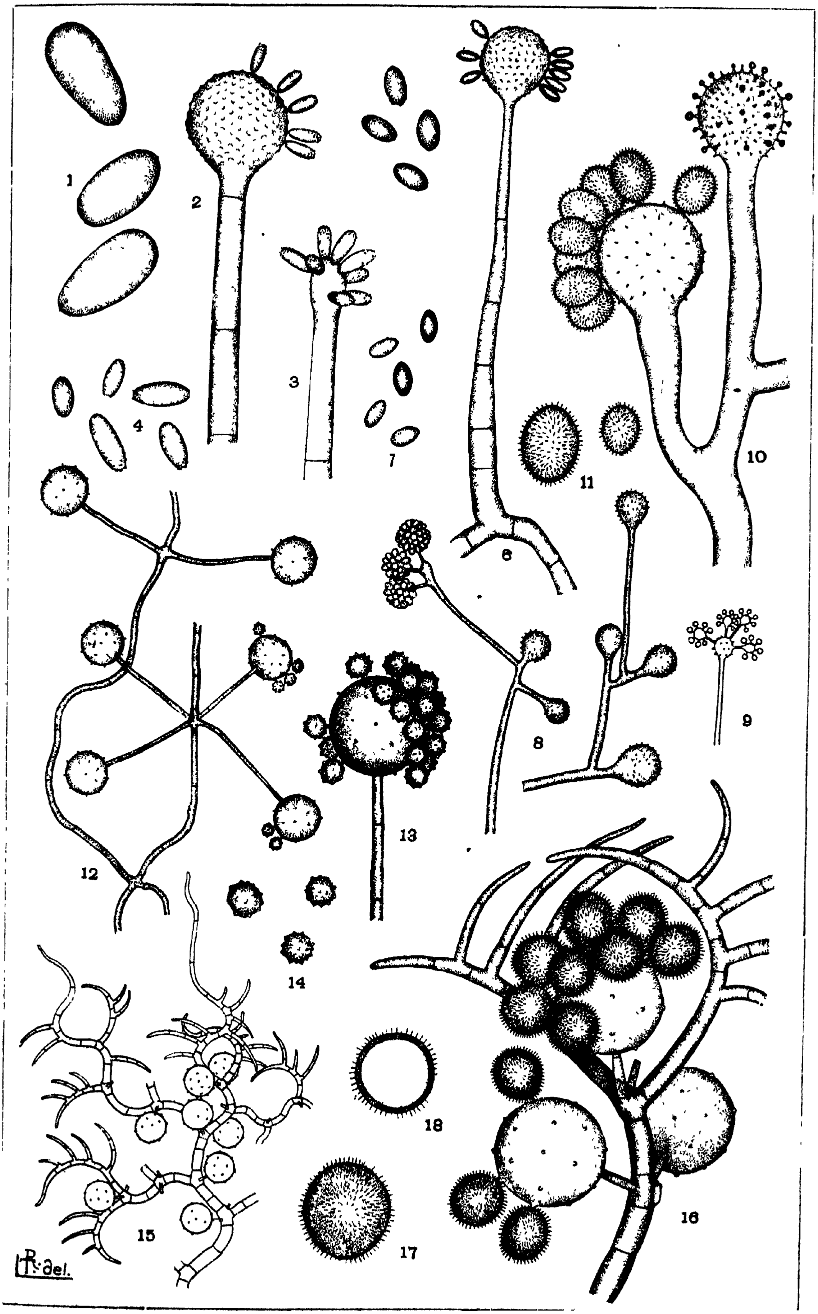
ROLAND THAXTER.

(WITH PLATES III AND IV.)

The species included in the above genera, although the similarity in their general type of fructification may justify their association for convenience as imperfect forms, must be considered as representatives of several widely different groups of so-called perfect fungi. Although in the plant subsequently described as a new genus there is at present no indication of any definite relationship to some higher form, there exists in the case of Rhopalomyces a probable connection with the Zygomycetes, as has been suggested by Van Tieghem,[1] while in Oedocephalum, a somewhat heterogeneous

[1] Bull. d. l. Soc. Bot. d. France, 1886, p. 494


1
2
3
4
5
6
7
8
9
R. del.


1
2
3
4
6
7
8
9
10
11
12
13
14
15
16
17
18
R. del.

collection of species, we must accept the studies of Vuillemin and Brefeld as proving a connection both with the Discomycetes and the Basidiomycetes. The first named author[1] in his cultures of a Peziza, which he calls *Aleuria asterigma* has clearly established its connection with an Oedocephalum (*O. fimetarium* Riess) found growing in company with it and also developed directly from germinating ascospores. Brefeld,[2] on the other hand, in cultivating the basidiospores of *Polyporus annosus*, in nutrient solutions, has obtained from them a hyphomycetous fungus which, although it is compared to Aspergillus in the text, and is subject to unusual variations when artificially cultivated, is in all essentials an Oedocephalum, and not referable to any other described genus.

No such proof of the connection of Rhopalomyces with the Zygomycetes has as yet been obtained; but its Syncephalis-like habit and mode of growth, together with the occurrence of supposed acroconidia, which have been observed by Van Tieghem and are similar to those which accompany the species of Syncephalis and Mortierella, give force to this supposition.

Costantin,[3] in his excellent synopsis of the simple Mucedines and elsewhere,[4] first clearly distinguished Rhopalomyces from Oedocephalum, restricting the former genus to a small number of species all characterized by the extreme differentiation existing between the fertile and the sterile hyphae; the almost complete absence of septa, and the large dark-colored conidia. The presence of areolations upon the surface of the fertile head was formerly considered as distinctive of Rhopalomyces, and this definition is adhered to by Saccardo in the Sylloge,[5] although the same character is, as was pointed out by Harz in his well known paper,[6] distinctly present in so typical a species as *Oedocephalum glomerulosum.* It may be mentioned that the last named author recognized neither Oedocephalum nor Rhopalomyces as distinct genera, referring both to *Haplotrichum* Lk. emended to receive them: an error

---

[1] Sur le Polymorphism des Pezizes. Ass. Franc. p. l'Avan. d. Sci., Congres d. Nancy, 1886.

[2] Untersuchungen, VIII Heft, Basidiomyceten III, p. 169, Taf. X, XI.

[3] Les Mucedinees Simples Materiaux p. l'Histoire d. Champignons. (Paris, 1888) Vol. II., p. 37.

[4] Bull d. l. Soc. Bot. d. France, 1886, p. 492.

[5] Sylloge Fungorum, Vol. IV., p. 50.

[6] Einige Neue Hyphomyceten Berlin's und Wien's, p 120. Plate I, fig 1, c. d.

which becomes manifest in the light of a more extended knowledge of existing forms.

In enumerating the American species of these two genera, the writer has therefore restricted Rhopalomyces as above defined, referring to Oedocephalum those species which are characterized by the presence of fertile hyphae nearly approaching the sterile in size or at least not supplied with rhizoid-like basal outgrowths for support, and as a rule, distinctly septate.

The forms at present recorded from this country appear to be confined to two species, *Rhopalomyces cucurbitarum* Rav. and *R. cervinus* Cke. In Europe, however, the number described is considerable, although the identification of many of them is beset by the difficulties which are usually associated with wretched figures, or diagnoses without measurements or mention of allied species for purposes of comparison. Since it is often somewhat difficult to form any opinion concerning them from the description alone, a brief synopsis of all described forms is here appended, which may perhaps be found of value in this connection :

Oedocephalum PREUSS.

OEDOCEPHALUM GLOMERULOSUM (Bull.) Sacc. Plate IV, fig. 1.

Oedocephalum glomerulosum Saccardo, Sylloge Fungorum, Vol. IV , p. 47. Costantin : Les Mucedinees Simples, p. 39, fig 6. Berlese, Fungi Moricoli, III., N. 2, fig. 1–5.

Mucor glomerulosus Bulliard : Herbier d. l. France, Pl. 504, fig. 3.

Haplotrichum glomerulosum Harz . Einige Neue Hyphomyceten Berlin's und Wien's, p. 120, Taf. 1, fig. 1. Saccardo : Fungi Italici, Pl. 804.

Haplotrichum roseum Corda : Prachtflora, p. 23, Taf. XI. Icones Fung II., Taf. 2, fig. 28.

Varying in color from nearly white to rose colored or yellowish. Sterile hyphae creeping, much branched and septate, about 6μ in diam. Fertile hyphae erect, solitary, tapering slightly upwards, septate, 8–9μ in diam. 200–350μ in height. Sporiferous heads spherical to obovoid, $35–50 \times 25–45\mu$: average $30 \times 38\mu$; often distinctly areolate. Spores oblong to obovoid, slightly pointed at the base and broader at the distal end, $9 \times 18\mu$, maximum $10 \times 30\mu$.

On old paper, decaying vegetable matter, dung of various animals. Massachusetts, Connecticut.

This species occurs very commonly on a great variety of substrata and is often troublesome in laboratory cultures,

completely occupying them to the exclusion of other and perhaps more desirable fungi. It varies from a decided rose or flesh color, which it often imparts to the substratum on which it grows, to pale whitish or yellowish: the color depending, in part at least, upon the amount of light to which it is exposed, and to the character of the substratum. The simple fertile hyphae also vary greatly in length and in the number of the septa, which may be almost wholly wanting. The areolation of the heads is distinct or otherwise, according to their condition of maturity, as well as to the illumination used in examining them.

In view of the observations of Vuillemin in connection with his *Alcuria asterigma* already referred to, it may be of interest to note that in several cultures made by the writer, that had been allowed to run for several weeks, there appeared repeatedly at various points on the old paper on which the fungus grew luxuriantly, a number of small Pezizae, flesh colored or whitish, about six millimeters in diameter and apparently developed from the same mycelium which gave rise to the Oedocephalum. Although asci were produced, no ascospores matured in them, so that cultures were impossible and no proof of the connection between the two forms was obtainable.

Saccardo in the Sylloge follows Harz in considering *O. elegans* Preuss a synonym of this species. The description and figure of *elegans*, however, which is given in Sturm, seem to indicate that the two are quite distinct: Preuss' species resembling *O. pallidum* (B. & Br.) in many respects. Whether Harz is correct in assuming that the present species is synonymous also with *O. album* and *O. alienum* of Preuss must remain uncertain, since these two species are hardly recognizable from either the figures or descriptions. The spherical spores described by Preuss, however, seem to separate both from *glomerulosum*, and Saccardo is doubtless right in keeping them distinct.

The *Oedocephalum roseum* Cooke, judging by the description and figure in Grevillea, can hardly be separated from the present species, of which it may be merely a short-stemmed variety.

Oedocephalum echinulatum n. sp.—Plate IV, figs. 8–11.

White becoming slightly yellowish. Sterile and fertile hyphae not clearly differentiated, the latter more or less irregularly and indefinitely branched. Fertile heads nearly

spherical to obovoid, very variable in size, more or less distinctly areolate: maximum $45 \times 65\mu$: average $28 \times 35\mu$. Spores oval to elliptical, finely echinulate: average $10 \times 12\mu$; maximum $18 \times 25\mu$.

On cheese and cheesy paper. Massachusetts.

This species, which made its appearance in company with several Mucors on a laboratory culture, is readily distinguished by its finely echinulate spores and very irregular growth. It resembles *O. dichotomum* Preuss in the successive branching of the fertile hyphae; but the type is not dichotomous, new heads usually arising by an out-growth from a point below the last head formed as in fig. 8. In some of its irregularities it approaches the conidial form of *Heterobasidion annosum* Bref. previously referred to, especially in the common occurrence of compound proliferation from the fertile heads, either before or after they have produced spores; each proliferation in its turn producing a smaller head and smaller spores as in fig. 9.

Oedocephalum verticillatum n. sp.—Plate IV, figs. 12–14.

White, becoming faintly yellowish. Sterile hyphae creeping, frequently septate, sub-verticillately branched. Fertile hyphae arising in whorls of from one to five; septate; 4μ in diam., tapering very slightly before swelling suddenly into the sporiferous head. Head invariably spherical; very faintly areolate; $20–25\mu$ in diam. Spores muriculate, spherical, slightly irregular in outline, $5–7\mu$ in diam.

On newt s dung. E. Tennessee.

This delicate species covers the substance on which it grows with an extremely evanescent mycelium; the hyphae running from one projecting point of the substratum to another and producing the fertile branches in the interval. The latter, therefore, arising in whorls in a usually vertical plane, are not always erect, some pointing downwards or outwards as well as upwards. The species does not appear nearly related to any of the described forms, from all of which it is readily separated by its verticillate habit and spherical muriculate spores.

OEDOCEPHALUM PALLIDUM (B. & Br.) Cost., Plate IV, figs. 2–7.

Oedocephalum pallidum Costantin Bull. Bot. Soc. d France, Vol XXXIII, p. 492.

Rhopalomyces pallidus Berkeley & Broome, Annals and Mag. of Nat. Hist., 2d Ser., Vol. VII, p. 96, No. 504, Plate V, fig. 2.

Rhopalomyces candidus Berkeley & Broome, l. c. p., 96, No. 505, Pl. V, fig. 3.

Haplotrichum fimetarium Riess in Fresenius Beitr. z. Mycol , III, p. 105, Taf. XIII, figs. 59-65.

Oedocephalum fimetarium Saccardo, Sylloge Fung., IV, p. 48

Rhopalomyces cervinus Cooke, Grevillea, Vol. XII, p. 27. Ravenel, Fung. Amer., 574. Ellis N A F , No 658

Aleuria asterigma Vuillemin Ass. Franc. p l'Avan d. Sci. Congrès d. Nancy, Aug. 1886, Vol. XV Pl. X.

Clear white, becoming brownish yellow to fawn-colored. Sterile hyphae creeping, septate: fertile hyphae erect, simple or once dichotomously branched. Fertile heads nearly spherical to obovoid, more or less distinctly areolate, 20–30μ in diameter. Spores oval or elliptical, sometimes slightly roughened toward the apex, 6–10$\times$4–16μ.

On old paper, decaying wood, dung of various animals, etc. Mass., Conn., N. Carolina, Europe.

This species occurs very commonly on laboratory cultures as well as old paper in refuse heaps. In one instance only I have found it covering the under side of a charred and decaying log in shady woods, with its fawn-colored fructification. The form on dung which corresponds to the *Haplotrichum fimetarium* of Riess, is usually smaller than the others, as far as I have observed, the spores not often reaching the length (10.7μ) given by Fresenius; and usually measuring about 8μ or less.

The synonymy of the species is somewhat confused, yet that given above is I believe correct. Through the kindness of Mr. Massee, to whom I am greatly indebted for sketches, with measurements of the types of *Rhopalomyces pallidus* and *candidus* B. & Br., the identity of these two supposed species is established beyond question, *R. candidus* having been based upon the different appearance which distinguishes immature from the mature individuals of *R. pallidus*. Again, *Haplotrichum fimetarium* Riess is separated by Fresenius from *R. pallidus* merely on the ground that its head showed no areolation. Since, however, this character is quite unreliable, being distinct or invisible, according to the condition of the head when examined, it cannot possibly be considered as a valid reason for keeping the two distinct. As a matter of fact the heads of the form on dung are often distinctly areolate. As Costantin has pointed out[1], the conidial form associ-

[1] Les Mucedinees Simples, p. 39.

ated with Vuillemin's "*Aleuria asterigma*" must also be added to the list. *Rhopalomyces cervinus* Cooke, as distributed in Ellis N. A. Fungi, No. 658, by Ravenel, and therefore presumably authentic, is identical with the common form, on dung, and the diagnosis in Grevillea also mentions no point of difference. Whether *O. elegans* Preuss may not be the same, must necessarily remain in doubt, although the figures and description in Sturm's Flora apply quite well to the present species, and are sufficiently definite at least to distinguish it with certainty from *O. glomerulosum*.

Rhopalomyces CORDA.

RHOPALOMYCES ELEGANS Corda.—Plate III, figs. 1–2.

Rhopalomyces elegans Corda Prachtflora, p. 3, Taf. 2. Anleit z. Stud. d. Mycol. p LXVI, Taf. B. 20, figs. 1–3. Fresenius Beiträge z. Mycol. I, p 19, Taf. III, figs. 9–15 Bonorden Handbuch d. Allg. Mycol, p 113, Taf. IX, fig. 184

Haplotrichum elegans Harz Einige neue Hyph. Berl. u. Wien's p. 118, Taf. V, fig. 5.

Sterile hyphae creeping, much branched, very rarely septate, 3–4 μ in diam. Fertile hyphae erect, more or less gregarious, colorless or slightly tinted, supported by rhizoids at the base which is usually slightly swollen, nearly cylindrical or tapering towards the apex, 1.5–0.75 mm. high, 18 μ in diam. Head nearly spherical, usually distinctly areolate, 50–80 μ in diam. Spores about 100 in number, dark-brown, ovoid to sub-cylindrical, slightly pointed at the base, 35–55 $\times$ 11–22μ.

On vegetable and animal matter of various kinds; bones, dung of animals, potatoes, squash rind, etc. Connecticut.

This well known species has occurred very frequently at New Haven on a variety of substances, although it is cultivated with difficulty, and I have been unable to induce the spores to germinate even in nutrient solutions. The spores vary considerably in size and shape and are usually nearly oval or long oval, seldom presenting the very elongate almost cylindrical form figured by Corda.

The supposed acroconidia described by Van Tieghem and resembling the similar productions of Morthierella and Syncephalis I have never seen.

RHOPALOMYCES CUCURBITARUM Berk. & Rav.

Rhopalomyces cucurbitarum Berkeley & Ravenel, Grevillea, Vol III, p. 109.

"Hyalinus; floccis inarticulatis; capitulis globosis echinulatis: sporis obovatis ovatisque."

On putrid squashes, Lower Carolina.

The exhaustive diagnosis above quoted has led to some uncertainty concerning this form, which, however appears to be a true Rhopalomyces and probably a distinct species.

Mr. Massee has kindly sent me a sketch from Berkeley's type with measurements which show that it is perhaps too closely allied to *R. elegans*, differing chiefly in its much smaller size. The creeping mycelium consists of the usual fine aseptate hyphae, from which the large, erect, fertile hyphae arise. The spores are represented as reddish brown, ovoid, slightly pointed at the base, and the head as spherical. The following measurements are noted: fertile hyphae 170–200μ high by 10–12μ in diam.: head 40–50μ in diam.: spores 18–20 $\times$ 9–10μ. It will be observed that these measurements hardly come within the limit of variation which *R. elegans* may be supposed to exhibit, and it is therefore necessary to consider the species distinct until more information concerning it can be obtained.

Rhopalomyces strangulatus n. sp.—Plate III, figs. 3–9.

Sterile hyphae copious, much branched and rarely septate, 4μ in diam. Fertile hyphae densely gregarious, supported by numerous rhizoids, pure white, cylindrical, 2–8 mm. high, (average 7.5 mm.) by 40–50μ in diam., suddenly constricted below the head with which it is connected by a narrow neck 8μ in diam. Head perfectly spherical, more or less distinctly areolate, beset with very numerous projections; average diam. 250μ. Spores, several hundred in number, subcylindrical; rounded at both ends, average dimensions 39 $\times$ 8.5–10μ.

On old bones and other decaying animal matter.— Massachusetts, Connecticut.

This remarkable species, which is the prince of its kind and one of the most beautiful of the Hyphomycetes seems to be not uncommon about New Haven, growing with great luxuriance on old bones, etc. in woods, appearing after rains in patches of considerable size, at first sight not unlike a vigorous growth of some large Mucor. A few specimens of the same species once followed a culture of Basidiobolus on frogs dung in Cambridge: but, like *R. elegans*, I have been unable to cultivate it on a large scale except on substrata where its mycelium was already growing, and all sowing and attempted cultures of its spores in water or in nutrient solutions have failed entirely.

The *R. nigripes* of Constantin which occurs upon *Peziza arenaria* approaches it in bearing a large number of spores: but is at once distinguished by its smaller size, dark color and by the absence of the peculiar constriction below the head present in our species.

Sigmoideomyces n. gen.

Fertile hyhae erect. septate, growing in sigmoid curves, intricately branched, the main branches subdichotomous or falsely dichotomous, the ultimate branches sterile. Spores solitary, thick walled, borne on the surface of spherical heads. Heads borne at the apex of short lateral branches which arise from opposite sides of certain cells in the continuity of the hyphae.

Sigmoideomyces dispiroides n. sp.—Plate IV, figs. 15–18.

Fertile hyphae forming brownish yellow tufts about 1 mm. high, coherent through the interlocking of the numerous curved branches, the main axis (and its principal branches) growing in a more or less regular succession of sigmoid curves, giving off the main branches from the convex side of each curve, the cell which bears the branch also producing a short, nearly cylindrical, lateral outgrowth from either side, in a plane at right angles to that of the branch. Each of these outgrowths is septate near its base and apex and terminated by a perfectly spherical head. Ultimate branches curved and sterile, sometimes greatly elongated, giving rise to a succession of still smaller curved sterile branches from their convex sides. Heads 38μ (35–45μ) in diameter. Spores broadly elliptical to nearly spherical, yellowish, finely echinulate, $16 \times 17\mu$.

On rotten wood. Burbank, E. Tennessee.

A single specimen of this peculiar plant was collected at Burbank on the under side of a moist log on which it produced a few scattered tufts of varying size. The fungus had reached maturity, and owing to the fact that it separates with great readiness at the septa, it was impossible to determine whether the fertile hyphae were produced from a few fine filaments which could be seen running upon the wood at the base of some of the specimens examined, or whether the sterile hyphae had wholly disappeared. The heads also break off when mature, even while the spores are still *in situ*, carrying with them the last cell of the short stalk which bears them. A certain number of the ultimate sterile branches are contin-

ued into sometimes greatly elongated simple septate filaments which may be seen with a hand lens projecting here and there beyond the general surface of the tuft.

The genus bears much the same relation to Oedocephalum that Dispira bears to Aspergillus, and the somewhat similar type of growth and branching seen in VanTieghem's species has suggested the specific name.

SYNOPSIS OF THE DESCRIBED SPECIES OF OEDOCEPHALUM AND RHOPALOMYCES.

Oedocephalum albidum Saccardo: Michelia, II., p. 288, (*sub* Haplotrichum), Fungi Italici, plate 805. The hyphæ of this species are described as hyaline and figured as brownish; fertile simple, rarely branched. Spores spherical or broadly elliptical, 7–10μ in diam., yellowish. On roots of lemon.

O. album Preuss: Fung. Hoyersw., No. 108: Sturm's Flora, Taf. 63. This is referred to *O. glomerulosum* by Harz, but is figured with round spores. Otherwise the description and plate furnish no clue to its identity.

O. alienum Preuss: l. c., No. 109, l. c. Taf. 63. This species is said to be distinguished from the preceding by the fact that the head lacks the warts and furrows present in *O. album*. The spores are also figured as spherical and the species is otherwise equally unrecognizable.

O. aurantiacum Cooke: Grevillea, vol. V, p. 147. Forms orange colored orbicular patches. Hyphæ short, fasciculate, septate, hyaline, above spherical and papillate. Spores spherical, orange-colored, smooth, (no measurements). On leaves of forest trees, India.

O. badium Von Müggenberg; Myc. Beiter., in Verhand. d. k. k. zool. bot. Gesell. in Wien, 1874. The heads of this species are said to produce longish cells, which are covered with muricate brown spores $7 \times 10\mu$. It is therefore not an Oedocephalum.

O. byssinum Saccardo: Sylloge, IV., p. 49. Bonorden Abhand. a. d. Geb. d. Mycol. II., p. 95, Taf. 1, fig. 12, *sub* Periconia. Karsten Symb. a. Myc. Fenn., 1888, XXVI, 4. p. 49, subspecies *herbariorum*. Hyphæ hyaline, hardly septate. Spores spherical. Karsten's sub-species has spores perfectly spherical, verruculose 12–14μ in diam. Fertile hyphæ 2 mm. $\times 15-20\mu$. Heads becoming yellowish. The type seems very near *O. albidum* Sacc. from the description. On decaying leaves.

O. crystallinum Cesati. This is said by Saccardo to be described on "p. 299" of the Botan. Zeitung, and figured in Hedwigia, 1, Taf. IV. fig. 3. I have not seen the original description. On Taf. IV, Vol. II, of Hedwigia fig. 3 represents an Oedocephalum which might be *O. glomerulosum*, but it is too coarse and ill-drawn to give any idea of its identity. A tedious search in the accompanying text shows no reference to it. According to Saccardo, the spores are hyaline, oblong, ovoid, becoming subochraceous. On Sporidesmium: distributed in in Klotsch, Herb. Viv. Myc., 1974.

O. dichotomum Preuss: Fungi Hoyersw. No. 271. This is peculiar for its successively dichotomous branches, which terminate in a head bearing brownish, finely muriculate globoso-ellipsoid spores. On Polyporus flavus.

O. fimetarium Riess: see above sub *O. pallidum* (B. & Br.) Cost.

O. glomerulosum (Bulliard) Saccardo: see above.

O. hyalinum Saccardo: Sylloge IV, p. 49, Bonorden, Abh. a. d. Geb. d. Mycol. II, p. 95, Taf. I, fig. 11, *sub* Periconia. Hyphae colorless, hardly septate. Head yellowish. Conidia small, spherical, hyaline. On decayed leaves. This seems too near *O. albidum* Sacc. and *O. byssinum* (Bon.).

O. lacticolor Berkeley & Broome: Ann. & Mag. of Nat. Hist., May, 1865, 3d Ser., Vol. XV, p. 403, Pl. XIV, fig. 12. Brick red. Fertile hyphae simple. Spores figured as elliptical and verrucose; described as spherical, granular, 15–20μ long, with a basal appendage. On cow dung. The figures are coarse and indefinite, but the species seems quite distinct.

O. pyriforme Saccardo: Sylloge, p. 49, Bonorden Handl. d. Allg. Mycol., p. 113, Taf. IX., fig. 196, *sub* Periconia. The hyphae of this species are described as aseptate. The spores are spherical or oval (figured as echinulate or verruculose) slightly blackish, hyaline. The head is grey green, and the whole plant in gross appearance resembles Penicillium glaucum. On Polyporus flavus.

O. Preussii Saccardo: Sylloge, Vol. IV., p. 49, Preuss, Fung. Hoyersw., No. 104, *sub* Periconia alba. Hyphæ white, septate. Spores subglobose, smooth. This species can hardly be identified from the description. On decaying leaves.

O. roseum Cooke: Grevillea, Vol. I, p. 184, ibid Vol. II., Pl. 22, fig. 8. "Rose pink, effused, or in minute punctiform

tufts collected together in irregular patches. Threads equal. Head subglobose: spores ovate or oval, smooth, attached by a slight apiculus. Cooke, Exs., No. 550. On old paper and rags." The description and figure corresponds closely with some varieties of *O. glomerulosum.*

O. sulphureum Cooke & Massee: Grevillea, Vol. XVII, p. 3. "Tufts hemispherical or confluent, sulphur colored. Threads septate, dichotomous, globosely capitulate at the apex, papillate, conidia globose. hyaline (3–5μ diam). Epispore smooth." On rope."

Rhopalomyces candidus Berkeley & Broome: see above sub *Oedocephalum pallidum* (B. & Br.) Cost.

R. cervinus Cooke: see above sub *Oed. pallidum* (B. & Br.)

R. cucurbitarum Berkeley & Ravenel: see above.

R. elegans Corda: see above.

R. nigripes Costantin: Bull d. l. Soc. Bot. d. France, 1886 p. 442. Les Mucéd. Simples, p. 37, fig 5.

Head and fertile hyphæ brown. Head 28 – 30μ in diam. Spores brown, elongate, rounded at one extremity, pointed at the other. 25–34 × 8–9μ. On Peziza arenaria.

R. pallidus Berkeley & Broome: see above sub *Oedocephalum pallidum.*

The writer desires to express his indebtedness to the kindness of Mr. Massee in communicating notes on Berkeley's types, as well as to Prof. Farlow, for the privilege of examining several of the works consulted.

New Haven, October, 1890.

Explanation of Plate III.

Rhopalomyces elegans Corda.

Fig. 1. Single fertile hypha with rhizoids ×68 Fig. 2. Four spores ×464

Rhopalomyces strangulatus, n. s.

Fig. 3. Fertile hyphæ natural size (as reduced.) Fig. 4. Fertile hypha ×68. Fig. 5. Fertile head mostly denuded of spores ×232. Fig. 6. Base of fertile hypha showing rhizoids ×232. Fig. 7. Five spores ×464. Figs. 8–9. Early stages in formation of fertile hyphæ ×232.

Explanation of Plate IV.

Oedocephalum glomerulosum (Bull.) Sacc

Fig. 1. Three spores ×696.

Oedocephalum pallidum (B. & Br.) Cost.

Fig, 2. Fertile head of form on dead wood ×464. Fig. 3. Abnormal spore production at apex of fertile hypha ×464. Fig, 4. Five spores of form on dead wood ×696. Fig. 5. Four spores of form on paper ×696. Fig. 6. Fertile hypha of form on horse dung (*O. fimetarium* Riess) × 464. Fig. 7. Five spores of form on horse dung ×696.

Oedocephalum echinulatum, n. s.

Fig. 8. Portions of fertile hyphæ showing inside of branching ×348. Fig. 9. Fertile head proliferating to form several secondary heads ×348. Fig. 10. Two fertile heads, one young, the other mature ×464. Fig. 11. Two spores ×696.

Oedocephalum verticillatum, n. s.

Fig. 12 Sterile and fertile hyphæ, showing verticillate habit ×232. Fig. 13 Single head ×464 Fig. 14 Three spores ×696.

Sigmiodeomyces dispiroides, n g. et n. s.

Fig. 15. Fragment taken from a fertile tuft, showing sigmoid habit; fertile heads denuded of spores when they have not fallen off entirely ×136. Fig. 16 Fragment bearing two pairs of fertile heads, one of which has fallen off ×464 Fig. 17. Spore ×696 Fig 18 Spore in optical section ×696

New Grasses.

GEO. VASEY.

Sporobolus pilosus, n. sp.—Perennial, from thick roots; whole plant pale green: culms cespitose, rigid, erect, about 1½ ft. high, leafy, particularly at the base, mostly simple, sheaths smooth, the uppermost sheathing the base of the panicle, the lower crowded and flattened; ligule inconspicuous; the throat, margin and both sides of the lower blades pilose, the upper ones involute and attenuated to a long point, shorter than the culm: panicle terminal, spike-like, 2 to 3 inches long, close, the lower part included in the sheath; spikelets 2½ lines long, smooth, the lower empty glume ¼ shorter than the upper, which equals the fl. gl. and palet, all obtuse.—Resembles S. asper, which has the leaves longer than the culm, both empty glumes shorter than the flower, and the leaves smooth or not pilose. Collected in Kansas, by B. B. Smythe.

Bouteloua uniflora, n. sp.—Perennial: culms 12 to 15 inches high, slender: culm leaves 4, the upper sheathing the base of the panicle, 1 line wide, the lower 3 to 4 inches long, rigid, becoming involute; ligule a ring of short hairs: panicle racemose-spicate, about 4 inches long, with 35 to 50 spikes, which are about 4 lines long, and but one flowered; lower empty glume linear-oblong, hardly half as long as the upper, which is between 3 and 4 lines long, acuminate, conduplicate, entire and scabrous on the midrib; flowering glume about

$2\frac{1}{2}$ lines long, and the palet about $1\frac{1}{2}$ lines; sometimes a small, weak, threadlike sterile pedicel present, sometimes wanting: immediately below the flower is the rachis, which is linear and about two-thirds as long as the spikelet.—Collected in Texas, by G. C. Nealley, in 1890. Related to B. racemosa, but differs in its smaller size and smaller, one flowered spikes.

ANDROPOGON MACROURUS, var. **pumilus,** n. var.—Perennial dwarf, tufted; culms 6 to 10 inches high, branching from the base, and terminating in a cymose panicle; leaves 3 to 6 inches long, longer than the internodes, smooth, the sheaths enclosing the lateral flowering branches, sparingly hairy at the throat; branches numerous at the upper sheaths, each subdivided, the sheathing bract rather longer than the pair of terminal spikes, which are 1 to $1\frac{1}{4}$ inches long, and with 10 to 12 spikelets; pedicel slightly hairy below the bract.—A remarkable variety, collected in Western Texas by G. C. Nealley.

Department of Agriculture, Washington, D. C.

BRIEFER ARTICLES.

Actinella (Hymenoxis) Texana, n. sp.—A small slender annual 5 to 15 cm. high, branching at base; leaves mostly radical, 3-nerved, oblong and tapering at base, entire or few-toothed; those of the stem narrower and toothed, becoming linear and entire above: heads small (4 to 6 mm. high): involucral bracts in 2 series; the outer ones about 8, rigid and keeled, united at base: rays minute, not projecting beyond the bracts; achenes pyramidal, 1 mm. long: pappus of 5 oval paleæ with aristate acuminations very conspicuous in mature heads. Collected by F. W. Thurow, near Hockley, Texas, 1889 and 1890; also mounted on a sheet with *A. odorata* (No. 742) of Palmer's 1879–80 collection from S. W. Texas. This little plant is evidently an Actinella, although it differs widely from any known North American form. The minute rays, not noticeable to the naked eye, and hence easily overlooked, under the lens suggest a relationship to the rayless species of South America. As presented by Dr. Gray in the Synoptical Flora, there is nothing to keep our species out of the section *Hymenoxis.* The involucre is very similar to that of *A. Rusbyi,* but in other respects the plant is very different. The achenes and pappus are very

similar to those of *A. linearifolia*, but the involucre is very different.—JOHN M. COULTER AND J. N. ROSE.

Anæsthetics and Transpiration.—Mr. C. P. Lommen finds that Jumelle's results regarding the influence of anæsthetics upon transpiration in green plants may be obtained quantitatively by the simple method of weighing on the analytical balance at intervals of a few hours. Sprigs of *Selaginella rupestris* Spring, were employed in a series of experiments, and the percentage of water lost under glass in darkness and in light, with and without ether, corresponded with Jumelle's general results as chronicled in the *Revue Generale de Botanique*, October, 1890. This affords a very simple and easy method of demonstrating the relation between transpiration and assimilation.—CONWAY MACMILLAN, *University of Minnesota.*

EDITORIAL.

Most advanced college students now-a-days are expected to secure some personal freedom of judgment by the independent investigation of a suitable subject. The larger part of such efforts do not rise to to the plane of an addition to recorded knowledge, but serve at the time to assist the student in his mental development. A strong student with the necessary preliminary training, however, may do work of scientific value, if it is properly planned and directed by the teacher in charge. But whether of value or not from the scientific point of view, if reasonable success is attained the work must be well outlined at the start, and to do this often taxes the teacher's resources. If he is interested in mycology, the natural tendency is to turn students into that line of work, if in embryological development, into that work, and so on. This secures the best assistance from the teacher, but does not always bring to light the pupil's special talents or aptitude where he is most likely to excel. An inability to successfully manage the delicate manipulations required for high class histological work, stands in the way of fair success for many students, and for several years past our laboratories have chiefly cultivated this field of research. The work outlined for the student should be adapted not only to his knowledge and maturity of judgment, but to his skill as a manipulator, and to do this the selection must be made through a wide range of topics. There is a field of research of absorbing interest, crowded with unsolved problems, and in which the use of the microscope can be largely dispensed with, hitherto much overlooked, and that is the physiology of movement in plants. The changes in position of leaves, stems and roots due to gravitation, heat, light,

moisture and various internal agencies, and other similar subjects possess all the elements required for a good thesis. There are excellent grounds for the belief that vegetable physiology will soon claim as much attention from American universities as minute anatomy did a short time since. At any rate, here is a field to be kept in mind in deciding upon themes for independent investigation.

CURRENT LITERATURE.

A General Treatise upon Fungi.

The fungi have presented many obstacles to a satisfactory treatment within the compass of a single volume, among which are the very large number of diversified forms ranging through a long and intricate series, the obscure polymorphic nature of many of the species, the much reduced structure and curtailed life cycle due to dependence upon organic food supply, and imperfect knowledge of physiological and biological phenomena. Of the several divisions of the subject, systematic, morphological, biological and physiological, we have had more or less well written general accounts of each, decreasing in number and importance in the order named, except of the last. For a knowledge of the physiology of fungi the student has been obliged to hunt up the scattered papers in journals and society proceedings, and incidental references in works upon other subjects. A treatise, therefore, which gives a satisfactory survey of the whole subject of fungi, with the several parts duly apportioned, can not but meet with hearty welcome. Such a work is Zopf's recently published volume on the fungi in their morphological, physiological, biological and systematical relations.[1] The author is well known by his able works upon the lower forms of life and by his numerous important researches.

Of the 500 pages in the volume 115 are devoted to morphology, 110 to physiology, 56 to biology and 204 to classification and development. Upon opening to the first page one finds that the author proposes to include in the work only the true fungi (Eumycetes), and to exclude the bacteria (Schizomycetes) upon morphological grounds as well as of expediency. No mention is made of the slime-molds (Myxomycetes) except in a footnote where they are said to be animals and not plants. The author has given much attention to these outlying groups of organisms and published several monographs upon them, and their

---

[1] ZOPF, WILHELM.—Die Pilze in morphologischer, physiologischer, biologischer und systematischer Beziehung. pp. xii, 500. figs. 163. Roy 8 vo. Breslau, Ed. Trewendt: 1890.—M. 18.

exclusion from the present work is indicative of a conservative course of treatment.

The morphological part comprises an account of the vegetative organs, organs of fructification including the mechanical contrivances for freeing the spores, the structure and formation of the cell, and its union into systems.

The physiological part opens with seventy pages upon the chemistry of the fungi, which contain a vast amount of information, as may be judged by the fact that there are nearly three hundred footnote references to literature. The part is continued in an account of respiration, development of heat and light, external forces influencing life processes, agents harmful to life, phenomena of movement such as heliotropism, hydrotropism, geotropism, rheotropism, movements due to contact and to chemical and electrical stimuli, and finally nutation and hygroscopic movements.

The biological part treats of saprophytism and parasitism, the means of infection, effect of the parasite upon the host, symbiotism, and the enemies of fungi.

In the systematic part the following classification is used:

I. Phycomycetes
- *a* Chytridiaceæ (*Olpidiaceæ*, etc.)
- *b* Oomycetes (*Saprolegniaceæ*, *Peronosporeæ*, etc.)
- *c* Zygomycetes (*Mucoraceæ*, *Entomophthoraceæ*, etc.)

II. Mycomycetes
- *a* Basidiomycetes (*Tremellineæ*, *Polyporeæ*, *Agaricineæ*, *Lycoperdaceæ*, etc.)
- *b* Uredineæ.
- *c* Ustilagineæ.
- *d* Ascomycetes (*Saccharomycetes*, *Erysipheæ*, *Tuberaceæ*, *Sphærieæ*, *Pezizaceæ*, etc.)

The work is copiously illustrated with well drawn figures, which, however, are not so well engraved and printed as one would expect. A good index of illustrations and another of subjects closes the volume.

Altogether no work of equal importance has heretofore appeared on the general subject of fungi, and its speedy translation into English is much to be desired.

The Silva of North America.

North America has always been noted for its forests, and permanent record concerning them should be made before they have been more extensively devastated. The only work upon the subject, giving detailed

descriptions, has been that of Michaux, supplemented by Nuttall, but this was necessarily incomplete. In the great work[1] now undertaken by Professor C. S. Sargent, the whole subject is to be presented in 12 quarto volumes, superbly printed and illustrated, the first of which has now appeared. Professor Sargent's connection with the forest volume of the 10th census is well known, and no one more competent could have been selected to undertake the work. That the plates will be all that can be desired is evidenced by the fact that the drawings are to be made by C. E. Faxon and engraved by Philibert and Eugène Picart. North American botanists are to be congratulated upon the appearance of this great work, and while its price will put it beyond many private purses, it should find its way into all public libraries, and should be considered a part of the equipment of every botanical department in our colleges. The definition of "trees" is a difficult one, and the author very rationally proposes to follow habit rather than size, a division which will include 422 species, besides numerous varieties. In nomenclature the rule adopted is to use the oldest generic name applied by Linnæus in the first edition of the "Genera Plantarum," published in 1737, or by any subsequent author, and the oldest specific name used by Linnæus in the first edition of the "Species Plantarum," published in 1753, or by any subsequent author, without regard to the fact that such a specific name may have been associated at first with a generic name improperly employed. Thirty-three species are included in this first volume.

Plants as rock-makers.

PLANTS have long been known to play an important part in the accumulation of travertine, though we doubt whether sufficient credit has been given to vegetation as a geological agent in this matter. In an elaborate memoir[2] by Walter H. Weed, forming part of the ninth annual report of the director of the U. S. Geological Survey, it is shown not only that very large deposits of travertine are due to the aid, direct and indirect, of vegetation, but also that the extensive deposits of siliceous sinter in the Yellowstone geyser region are in large part due to the separation of the silica from the water by plants.

[1] SARGENT, CHARLES SPRAGUE.—The Silva of North America, a description of the trees that grow in N. Am. exclusive of Mexico, Vol. I. Magnoliaceæ-Ilicineæ pp. ix 119, 50 plates, large 4to, Boston and New York Houghton Mifflin & Co, 1891.—$25 per volume.

[2] WEED, WALTER HARVEY.—The formation of travertine and siliceous sinter by the vegetation of hot springs pp. 619–676, 9th Ann. Rep't, U. S. G. S. figs. 5, pls. 10. Imperial 8vo. Washington: Government Printing Office, 1890.

Just how this elimination of silica is accomplished Mr. Weed does not say, and the matter really lies outside his province. Algæ are the chief agents in this work, and in the cooler waters at some distance from the springs mosses also assist. Cladothrix gypsophila, Mastigonema thermale, Leptothrix laminosa, and Leptothrix sp.? are the chief filamentous forms found growing in the hot waters. Various diatoms, Denticula valida in particular, eliminate silica from the tepid waters of the marshes about the Hot Springs, and their dead tests make up the bulk of the ooze which forms the soil of these marshes. The moss found in the warm waters was Hypnum aduncum var. gracilescens. The memoir is an interesting contribution to the knowledge of vegetation as a geological agent.

Minor Notices.

WITH THE APPEARANCE of Part V, devoted to Pteridophytes, Professor John Macoun's Catalogue of vascular Canadian Plants has been completed. It has been very handsomely done and the painstaking care so evident through it all has made it a mine of information concerning the Canadian flora. The present part brings up the generic numbers to 764, the specific to 3,054. A large appendix brings together additions and corrections to Parts I–IV, the results of all monographic work done since the beginning of the catalogue being included. It is promised that Part VI, soon to appear, will include Characeæ, Musci, and Hepaticæ, about 1,000 species in all. The part is rounded out by a complete index to all the parts, and the five will make a very complete and compact volume.

ALONG WITH the preceding comes a list of Canadian Hepaticæ, by Wm. Hy. Pearson, published in the same style, and containing 12 full page plates.

OPEN LETTERS.

The word "Biology."

An open letter from a "Prominent Zoologist" brings a breath of "*Bion*" into the October *Gazette*. In it, an original and characteristically unsearchable defence is proposed for the current etymological piracy *in re* the word "biology." It is probably the same "prominent zoologist"—if one may judge by kinship of orthographic recklessness—who presents, editorially, in the Nov. *American Naturalist* a similar sin against rational use of terminology. The argument perpetrated by the GAZETTE letter and perpetrated in the *Naturalist* editorial is as follows: "Zoologists were the first to study life; therefore they have a prior right to the word *biology*." The truly "biological"

lapse in the major premise is not altogether unapparent to those who recall the fostering care of botanists—such as Darwin for example—while putting the infant industry of the zoologists on its feet. Why, even Huxley looks upon his long zoological training-course as a means of fitting him for extended study of the Gentians. An additional and quite unanswerable argument is brought forward, however, in the *Naturalist* editorial. "On a broad etymological basis the use of the word by zoologists is wrong," observes the writer. And then he straightway insists upon the right to use it. The peculiar appropriateness of an incorrect word for a one-sided, incorrect science is felt by us all. Indeed, as an additional evidence of true "biological" wrath at the philological pharisees and purists, the "prominent zoologist" proudly parades in his GAZETTE letter a Greek termination which we sincerely hope is not to be found elsewhere. At least the dictionaries, being written on the much despised "broad etymological basis" may be relied upon to exclude it.

Apparently the trouble with the prominent zoologist is this: In college days he was probably brought under the influence of Dr. Mark Hopkins, of venerated memory, and he has adopted one of the contestable *dicta* of his early philosophic mentor. It was a pleasing idiosyncrasy of Dr. Hopkins to insist that a "profound abyss" yawned between plants and animals. "Certainly," thinks the disciple. "'Life' characterises animals and, since there is the profound abyss I learned about, plants must be in a condition of partial paralysis and the biologist should shun them." This is what the editor of the *Naturalist* means when he speaks of the "living side" of the plant-world as if there was any side *not* alive. The same confused, altho Hopkinsesque, notions of plants and animals so characteristic of half-biologists, are shown again in the *Naturalist* editorial when it is said—"fully one-half of the teachers of botany are unable to give any of the living side of their subject. * * * The zoologist teaches *all that is taught* of life." The intimation is plain that the "living side" taught by the other half of the botanists is very different from the "life" (or in the *original* Greek *Bion*) which zoologists wish to claim as their peculiar province. A little less slavish knuckling down to the Mark Hopkins school, a little more Greek and a good deal more biology would make the "prominent zoologist" something of an orthographic authority.—AN OBSCURE AND ORDINARY BOTANIST.

Labeling specimens for the herbarium.

The usefulness of the herbarium is largely determined by the excellence of the labelling. Bearing this in mind, I cast about for a method of labelling the specimens in my herbarium, and, finally after having read of the methods used here and there and finding none that suited me exactly, I thought of the following way which has proved one of so great neatness, excellence, fulness and easeness as to lead me to mention it for the instruction of others who desire to render their collections more serviceable. In labelling my herbarium I used the printed names and descriptions clipped directly from the revised Manual. I labelled my shelves with the printed ordinal name, but could not use the descriptions. The genus covers have the generic

name and description neatly pasted upon them. Each species paper has the generic initial and the specific name and description pasted upon it. This method virtually converts my herbarium into an invaluable *illustrated Gray's Manual,* and in my opinion is more handy than it would have been had I adopted the methods currently advocated.—WM. E. ANDREWS, *Blackburn University, Carlinville, Ill.*

NOTES AND NEWS.

MR. E. J. HILL is writing a series of articles for *Garden and Forest,* on the autumn flora of the Lake Michigan pine-barrens.

M. W. BEYERINCK has succeeded in isolating some of the very small algæ by a modification of the gelatine-plate process used by bacteriologists. Cf. *Bot. Zeit.*, 48, 725.

THE *Journal de Botanique* (Nov. 16), contains an account of the *Piperaceæ* of Ecuador, New Grenada, and Peru, in the collection of M. Ed. André, with descriptions of many new species, by M. C. De Candolle.

M. E. BOURQUELOT has examined the sugar in a large number of species of Boletus, as well as some Amanitas. He finds the sugar when the plants are young to be almost always tréhalose (2.7—7.8 per cent.), which is replaced with increasing age by mannite.

DR. THOMAS MORONG has returned from his long South American trip, and has been appointed curator of the herbarium of Columbia College. Mr. Morong is to be congratulated upon his successful trip, and upon the very congenial and fitting position that he found awaiting his return.

A VERY INTERESTING discovery of an arctic plant in Alpine regions, was made last summer by Professor M. A. Carleton, of Garfield University, Wichita, Kansas. *Douglasia arctica* Hook., known only from our northwestern arctic seashores, and poorly known even from that locality, was discovered on Pike's Peak, Colorado.

AN ELEVATION of temperature of 20° C., due to growth was observed by H. Devaux (*Bull. Soc. Bot. de France,* xxxvii, 168) in a pile of stored potatoes that had produced sprouts a foot or so long. The surrounding air indicated 18 to 19° C., the tubers on the outside of the pile 1 or 2 degrees higher, and at the center of the pile, 2 meters from the surface, the temperature stood at 39° C.

MM. SCHLOESING, JR. AND LAURENT have shown by a direct method that the Leguminosæ can fix free nitrogen. Instead of determining the amount of N in the seed and subsequently the amount in the crop, they measured the N, O, and CO_2 introduced into a chamber with growing plants. After three months they again determined these gases, when the N was found to have diminished. Every precaution seems to have been taken against error.

A CANADIAN Botanists' Correspondence association was formed in December last, composed of botanists who collect and preserve specimens of the Canadian flora, and who are willing to afford information and assistance to others in the study of botany. A variety of other good objects is set forth in their constitution, and the whole movement deserves hearty support and encouragement. The officers who constitute the executive of the association are John Dearness, London, Ontario, chairman, and J. A. Morton, Wingham, Ontario, secretary.

AT THE LEEDS meeting of the British Association, the subject of teaching botany in the schools was discussed. Professor Marshall Ward introduced it, and in the discussion that followed it was evident that British botanists are becoming aroused to the attitude that their American brethren have held for many a long day. They agreed "that it is time to leave the blind worship of facts, and instead of measuring a scholar's progress by the amount of dogmatic information imbibed and put into an examination paper, to look to his understanding of the relation between facts and the intelligence with which he describes what he sees." We had imagined that any sentiment contrary to this had gone out with the coming in of laboratory methods.

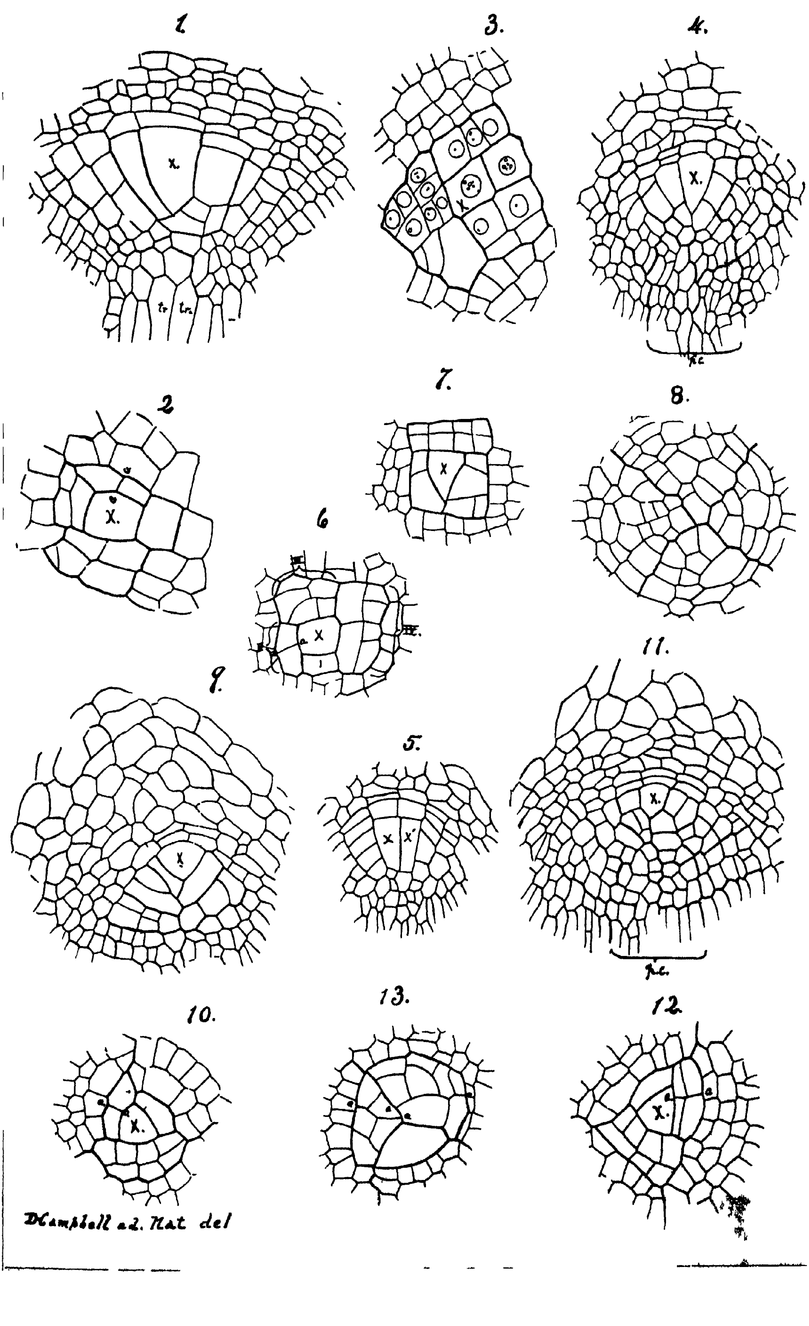
VINCENT CHMIELEWSKY has reëxamined the behavior of Spirogyra in conjugation, and particularly the changes in the formation and growth of the zygospore. He finds that the protoplasm of the male cell acts only as a vehicle for the transportation of the nucleus, the essence of the act of fertilization being the union of the male and female nuclei. The chlorophyll band or bands, pyrenoids, etc., instead of uniting with the corresponding structures of the female cell, as has been believed, become disorganized. Traces of these disorganized parts remain in the zygospore even till germination. Only the persistent structures of the female cell enter the tube which is formed on the germination of the zygospore. These observations, while differing very materially from those of other observers, coincide more closely with what we know of fertilization in other plants.

IN THE LAST *Bulletin of the Torrey Botanical Club* (Dec.) Dr. N. L. Britton presents his third contribution entitled, "New or Noteworthy N. Am. Phanerogams." *Ranunculus Porteri* is a new species from Henry's Fork, collected some years ago by the Hayden survey. The somewhat unsatisfactory label reads very much as though the plant had been collected in 1872, when J. M. Coulter was the collector. *Capsella divaricata* Walp. is thought to be identical with the Old World *C. procumbens* L.; it is suggested that *Hypericum Canadense* L., var. *majus* Gray is worthy of specific rank; *Calandrinia pygmæa* Gray is made *C. Grayi* Britt. on account of an earlier Australian species bearing the former specific name; *Lotus Helleri* is a new species disentangled from *L. Americanus* Bisch. (*Hosackia Purshiana* Benth.); *Spiræa Virginiana* is a new species from W. Va.; and a new Cyperus from Key West is described.

THE PROCEEDINGS of the eleventh meeting of the Society for the Promotion of Agricultural Science, held last August in Indianapolis, have been distributed. The most notable botanical article in the volume is the index to the common names of grasses, compiled by Prof.

Lamson-Scribner. It covers eighteen pages, and appears very complete. The other botanical articles are short, and part are in abstract. They are as follows: Preliminary notes upon the rotting of potatoes, by T. J. Burrill; Scab of wheat heads, by Clarence M. Weed, describing a Fusisporium; Recent observations on black rot of the grape, and comparative test of copper preparations for black rot of the grape, by B. T. Galloway; Some fungus root diseases, by L. H. Pammel. The abstracts are: Forage problem of the plains, by C. E. Bessey; Rots of the sweet potato, by B. D. Halsted; Cucurbita an American genus, by E. L. Sturtevant; Some biographical factors in the nutrition of plants, by M. Miles.

THE INDIANA ACADEMY OF SCIENCES met at Indianapolis December 29–31. The botanical papers announced were as follows: *Stanley Coulter*, Preliminary note on the genus Polygonum, Aberrant fruit of Juglans nigra, Value of minute anatomy in plant classification; *D. T. McDougal*, Aberrant forms of Juglans nigra; *David M. Mottier*, Notes on the apical growth of liverworts, Notes on the germination of spores of Notothylas; *J. C. Arthur*, A remarkable oscillating movement of protoplasm in a Mucor, Accelerating germination by previous immersion of the seed in hot water; *Henry E. Seaton*, Notes on Guatemalan Compositæ; *E. M. Fisher*, Parasitic fungi of Indiana; *John Morgan*, Circulation of sap; *J. N. Rose*, Distribution of Peucedanum in N. Am., Plants collected by Dr. Palmer in Arizona in 1890; *D. H. Campbell*, Comparative structure of the roots of Osmunda and Botrychium, Notes on the prothallium of the Osmundaceæ; *H. L. Bolley*, Notes on a new Puccinia, On the manufacture of plant infusions for the culture of bacteria; *W. P. Shannon*, The occurrence of Veratrum Woodii in Decatur Co., Ind.; *Joseph H. Tudor*, Some features in the occurrence of Viola pedata, var. bicolor; *W. J. Spillman*, Preliminary list of Knox Co. plants, Introduction of noxious weeds; *Katherine E. Golden*, Weight of seed in relation to production; *John M. Coulter*, Biological surveys, The flora of Texas.


1.
3.
4.
7.
2
8.
6
11.
9.
5.
10.
13.
12.
X.
tr
tr.
p.c.
X'
D.Campbell ad. Nat del

VOL. XVI. NO. 2.—BOTANICAL GAZETTE.—FEB., 1891.

Notes on the apical growth in the roots of Osmunda and Botrychium.

DOUGLAS HOUGHTON CAMPBELL.

(WITH PLATE V)

With the rapid advance in histological methods, it has now become possible to study with the utmost exactness the development of the most delicate plant tissues, and in consequence a new impulse has been given to the investigation of the histogeny of the higher plants, with a view to elucidating their affinities.

Naturally the Pteridophytes have been among the most frequently investigated forms, and my purpose here is to put in brief form the results of some observations on the growing points of the roots of Osmunda and Botrychium, which may serve to supplement the more extended researches of other authors on the ferns.

Of the genus Osmunda, O. regalis has been exhaustively studied by Bower[1], but our other native species, O. cinnamomea, and especially O. Claytoniana are, so far as their histology is concerned, almost unknown.

These species, therefore, were chosen for the examination of the roots. Of the genus Botrychium, B. ternatum, and B. Virginianum were used.

The roots were fixed with a 1 per cent aqueous solution of chromic acid, or in some cases with Flemming's chrom-osmic-acetic-acid mixture, but the former was found to give the best results. After thoroughly washing, to remove all traces of the acid, and then dehydrating, the specimens were brought gradually through turpentine and then imbedded in paraffin and sectioned on a Minot microtome. Various stains were tried, but by far the most satisfactory was a solution of Bismarck-brown in 70 per cent. alcohol. The specimens were stained on the slide with this mixture, which stains the young cell-walls strongly, and renders the study of the earlier cell-divisions an easy matter.

---

[1] Bower: The comparative examination of the meristems of ferns as a phylogenetic study. *Annals of Botany*, vol. iii, no. 9, Aug. 1889.

OSMUNDACEÆ.—The Osmundaceæ differ in several respects from the true leptosporangiate ferns, seeming to connect the latter, to a certain extent, with the Marattiaceæ, and perhaps with the Ophioglosseæ. An examination of sections of the root-tips shows that the almost mathematical regularity that prevails in the segmentation of the apical cell of the Leptosporangiatæ and Equisetum is here very much less evident. Bower[1] states that in O. regalis there may be a single apical cell of the same form as in the leptosporangiate ferns, but that it never shows the same regularity in its segmentation, and that it may be replaced by two or three initial cells, or a single four-sided pyramidal initial. In Todea barbara[2] (also one of the Osmundaceæ) he found usually four similar initial cells, and in no case a single one, although Van Tieghem and Douliot[3] ascribe to this species a single apical cell of the ordinary fern-type.

Of the two species investigated by me, O. cinnamomea approached, on the whole, more nearly the forms described and figured by Bower; O. Claytoniana resembled more the ordinary fern-type in the regularity of the segmentation of the apical cell, although this seems to be regularly a four-sided pyramid, instead of three-sided as in the other true ferns.

Osmunda cinnamomea.—This species seems to correspond in many respects with O. regalis. The roots are stout, and sections, either transverse or longitudinal, show the cells at the growing-point to be very large, with correspondingly large nuclei, but relatively little protoplasm. In all specimens examined, there appeared to be a single initial cell, but owing to the large size of the young segments, it was not always easy to determine positively that this was the case; but a careful examination of the sections led to the conclusion that all the cells were traceable to a single apical cell.

The apical cell, seen in profile, is more or less regularly triangular (fig. 1), but may be truncate at the base. In all the transverse sections examined, this cell appeared nearly square, so that the normal form of the apical cell in this species appears to be a four-sided pyramid. In transverse sec-

[1] L. c., p. 310.

[2] L. c., p. 314.

[3] Van Tieghem et Douliot: L'Origine des Radicelles, *Ann. des. Sci. Nat* (Bot.) 1888, vol viii, pp. 378–380. These authors state that all the Osmundaceæ examined by them have a single apical cell, essentially like that of the other ferns, but their accounts are very brief.

tions (figs. 2, 3), the adjacent cells are sometimes of nearly the same size and shape as the apical cell; but this position generally shows plainly that they are derived from it, and the relation of the young segments to the apical cell may be readily made out (fig. 2). It is, of course, not impossible that here, as in Todea, there may be sometimes four initial cells, but this view is not supported by my own observations.

Owing to the slowness of cell-division in the young segments, and the comparative irregularity of the same, it is difficult to trace the limits of the segments beyond the youngest ones.

The apical cell, as in O. regalis, is deeper than in most Filicineæ, but from its faces the segments are cut off much as in the latter. The segments usually form a spiral, although cases were met with that looked as if this were not the case, but that they arose in pairs from opposite sides of the four-sided initial-cell. From the outer face segments are also cut off, and these contribute to the growth of the root-cap, but this is also formed in part from cells cut off from the young lateral segments (fig. 1).

While the earlier divisions of the young segments do not follow any absolute rule, nevertheless they correspond in the main to those observed in the other Filices. The first wall in the young segment usually divides it radially into two cells, one of which is deeper than the other, as the wall does not exactly bisect the segment. This is followed in each semi-segment by a transverse wall that separates an inner small cell from an outer larger one. The former, as in the other ferns, probably gives rise only to the plerome-cylinder; the latter to periblem and dermatogen, and in part also to the root-cap (fig. 1). As the root-cap is derived both from the outer segments of the apical cell and the outer cells of the lateral segments, its inner layers lack that regularity that is so marked in most ferns; but as the cells enlarge this irregularity is in great part lost, and the outer layers of cells show a stratified appearance, nearly as regular as in the other Filices.

The plerome cylinder is in this species especially large, somewhat oval in section, but with poorly defined limits, so that it is not possible to state positively whether or not it owes its origin exclusively to the innermost cells of the segments. Occupying the center are several very wide cells that early cease to divide and are very conspicuous. These are

the young tracheæ, and in this species are especially noticeable (fig. 1, *tr*).

Osmunda Claytoniana.—On comparing the roots of this species with the foregoing, we are struck first by their smaller size; and on examining the growing-point, the cells show a corresponding decrease in size, as well as greater regularity in the divisions of the apical cell and its segments. As in O. cinnamomea, the apical cell appears in vertical section deeply triangular, or occasionally truncate below. In one case (fig. 5), which closely resembles Bower's figures, 10 and 14[1], two cells of very similar appearance occupied the growing point, but the smaller of these two, x', was probably a segment of the larger one, x, which is to be regarded as the real apical cell. In transverse sections, a single, four-sided cell was met with in nearly every case, and from its position, and that of the surrounding cells, was unmistakably the single initial cell. It is usually quite regularly oblong, and the divisions of the segments show a very considerable degree of regularity. In no case was a regular three-sided apical cell met with, although in one section (fig. 7) it was nearly of this form; but an examination of the adjacent segments showed that this was in all probability only temporary, as the youngest set of segments formed a nearly perfect rectangle, and the three-sided form of the apical cell apparently arose from the walls cutting off segments on opposite sides of the cell deviating so far from their normally parallel direction as to intersect.

Sometimes the arrangement of the cells seen in longitudinal section is almost as regular as in the Polypodiaceæ or Equisetum (fig. 4), and in such cases the limits of the segments are traceable for a long time; and in transverse sections this is also evident for the first complete set of segments (fig. 6). From a study of both, the successive divisions in the young segments may be plainly determined. While not as diagramatically regular as in the true leptosporangiate ferns, nevertheless the divisions are much more definite than in either O. regalis or O. cinnamomea, and except for the irregularity in the formation of the root-cap, correspond very closely to the regular fern-type. The primary tissue-systems are better differentiated, and the plerome-cylinder may be traced back with certainty, at least in such regular forms as

[1] L. c., pl. xx.

that shown in fig. 4, to the inner of the two primary cells into which each semi-segment is divided.[1] (fig. 4, *p. c.*). The plerome-cylinder is much smaller than in O. cinnamomea, and in its mature condition resembles very closely the bundle of the ordinary fern-root, and differs from the investigated species of Osmunda and Todea[2] in the better development of the bundle-sheath and in having the pericambium consisting of but one, or at most two layers. The arrangement of the tracheary tissue, too, is entirely similar to that of the Polypodiaceæ.

OPHIOGLOSSEÆ.—Unfortunately at the time these investigations were made, only a very small number of plants of Ophioglossum were obtainable, and the roots of these were not properly prepared for imbedding, the plants having been preserved in ordinary alcohol, so that it was impossible to get satisfactory preparations, and my observations were therefore confined to the two common Botrychia, B. ternatum and B. Virginianum.

The Ophioglosseæ have been comparatively little studied,[3] and the investigations that have been made on the roots are not satisfactory. B. ternatum was examined by me some time since,[4] and the results of the paper then published were confirmed for the most part; but somewhat less regularity in the segmentation of the apical cell was found to exist than there described, and a consequent departure from the ordinary fern-type.

Botrychium ternatum.—The apical cell of this species (fig. 9) is in form quite like that of the Polypodiaceæ, but the segments are noticeably larger and remain longer undivided, in which respect they approach the Osmundaceæ. The first division in the young segment (fig. 10) follows the regular rule, dividing it lengthwise into two cells, which are, however, more unequal than is usually the case in ferns, and the subsequent divisions are less definite, although they follow the same general rule. Here, as in the Osmundaceæ, the

[1] Van Tieghem and Douliot call attention to the fact, confirmed by the observations recorded here, that the Osmundaceæ differ from the other ferns in having the innermost of the two primary cells of the semi-segment smaller, and giving rise directly to the procambium (l. c. p 379.)

[2] De Bary: Comp. Anat. (Eng. translation) p 364.

[3] Holle: Ueber die Vegetationsorgane der Ophioglosseen; *Bot. Zeit.*, 1875.

[4] Campbell: The development of the root of Botrychium ternatum; *Bot. Gazette*, March, 1886.

plerome initial cell becomes separated before the division of the outer cells of the segment and the initials of the periblem and dermatogen.[1] The cap segments, however, show much less regularity, and the stratification of the root-cap is soon entirely lost. Comparing, too, the apex of the root (exclusive of the root-cap) with that of most other ferns, it is found to be much more convex.

Botrychium Virginianum.—Comparing the root of B. Virginianum (fig. 11) with B. ternatum, while the structure on the whole is closely similar, the former species approaches more nearly the fern-type. Sometimes (fig. 12) the cross-section shows almost as perfect regularity as in the Polypodiaceæ, and this is evident, too, though to a less degree, in longitudinal sections. The root-tip is flatter than in B. ternatum, and the stratification of the root-cap more evident, although much less so than in the Filices.

CONCLUSIONS.—As a result of the foregoing statements, it appears that in the Osmundaceæ there may be very considerable variations in the structure of the root-tip, and that of our native species, O. Claytoniana, on the whole, departs least from the ordinary fern-type, and may be looked upon as the most nearly related to the true Leptosporangiatæ.[2]

Of the two species of Botrychium, B. Virginianum approaches more nearly the Filices in the structure of its roots, as it does in other respects.[3] A further investigation of Ophioglossum and the simpler species of Botrychium will probably show in these a still further departure from the type than in B. ternatum.

Bloomington, Indiana, November, 1890.

EXPLANATION OF PLATE V.

All magnified about 175 diameters. *x*, apical cell. *a*, *a*, the primary wall in the young segment The boundaries of the younger segments are indicated by the heavy lines.

Figs. 1-3. Osmunda cinnamomea. Fig. 1, longitudinal; 2 and 3, transverse sections. *tr*, young tracheæ.

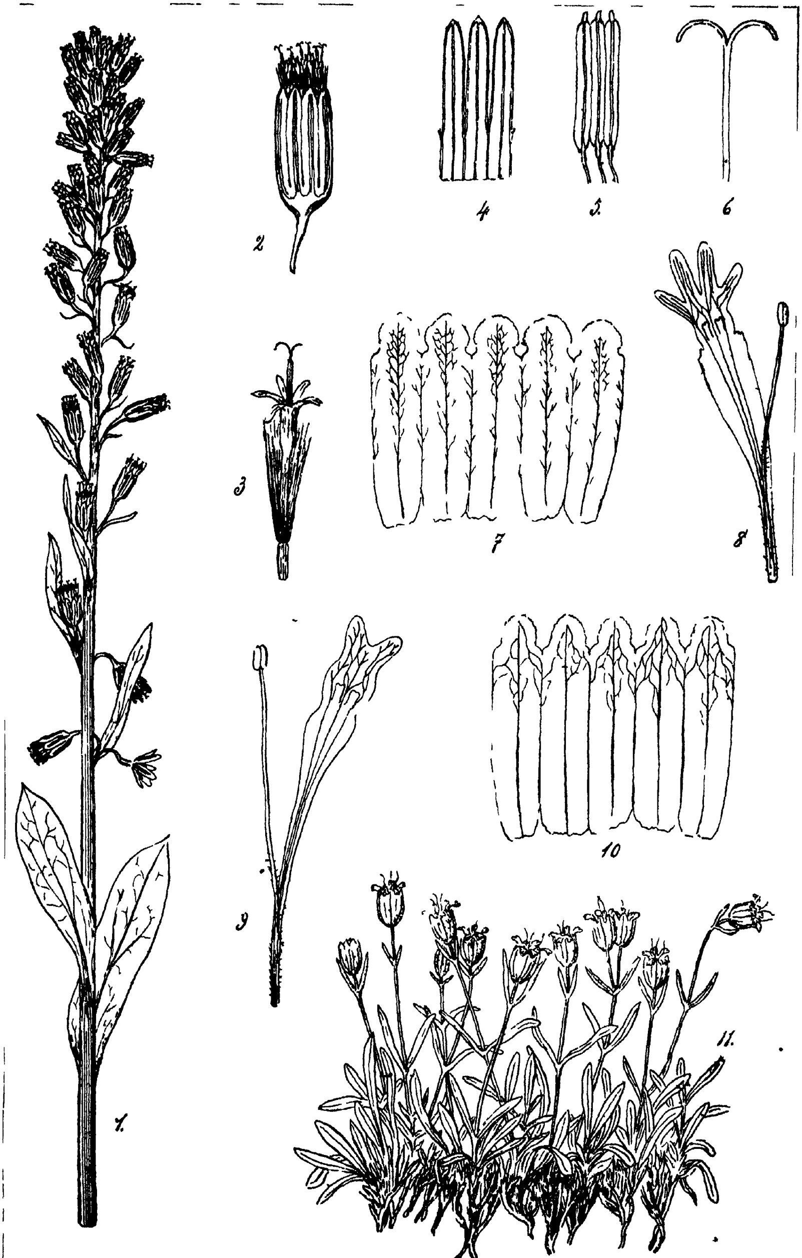
Figs. 4-8. O. Claytoniana. 4, 5, longitudinal; 6, 7, transverse sections. Fig. 8 is a transverse section a short distance below the apical cell In fig. 5 the youngest segment (*x'*), closely resembles in form the true initial cell (*x*).

---

[1] Van Tieghem and Douliot dispute the view that the epidermis of the root in any ferns is derived from the lateral segments at all, but claim that it originates from the outer segments, the same that form the root-cap

[2] The conclusion given here, based upon the roots, is also confirmed by a study of the prothallium, which in several respects resembles the Polypodiaceæ more closely than does either O cinnamomea or O. regalis.

[3] Campbell: On the affinities of the Filicineæ; *Bot. Gazette*, Jan., 1890, p. 5.



ROBINSON on LUINA and SILENE

Figs. 9, 10. Botrychium ternatum. 9, longitudinal; 10, transverse section.
Figs. 11, 12. Similar sections of B. Virginianum. *p. c.*, procambium cylinder.
Fig. 13. Transverse section of the root of B. ternatum just below the apical cell. The outlines of the first three segments are distinguishable.

Two new plants from the Cascade Mountains.

B. L. ROBINSON.

(WITH PLATE VI.)

In a small collection of phænogams from Mt. Rainier and vicinity, sent by Mr. C. V. Piper to the Gray Herbarium, two new species occur, which form the subject of the present paper. One of them is more or less closely related to *Luina hypoleuca* Benth. and *Cacaliopsis Nardosmia* Gray, and is of special interest, since it does not fall strictly within the limits of either genus as now described. Since, however, both of these genera are monotypic it seems highly injudicious to add a third genus to the group, intermediate between the two, and also of a single species. As will be seen from the description that follows, the new species resembles, on the whole, the older genus Luina more closely, the most important point in which it differs from it being the entire or subentire base of the anthers, in which respect it is more like Cacaliopsis. In its sessile entire leaves, few-flowered oblong heads with few rigid involucral scales, it accords with Luina. Its inflorescence is still more racemose than in Cacaliopsis, and, as in that genus, the upper bracts are adnate to the pedicels; in the entire absence of pubescence from stem and leaves, in the tawny pappus, and in some characters of the corolla it differs from both. While highly probable that Luina should be made to include Cacaliopsis, this point may well be left for future discoveries to decide. The characters of the new species are as follows:

Luina Piperi. (Pl. VI, figs. 1–6).—Stem simple, virgate, striate, glabrous: cauline leaves oblong-lanceolate, shortly acuminate, narrowed to sessile base, entire, in the single type specimen green and glabrous on both sides; radical leaves unknown: inflorescence racemose, one foot long; pedicels 2–6 lines long, together with the involucral scales somewhat to-

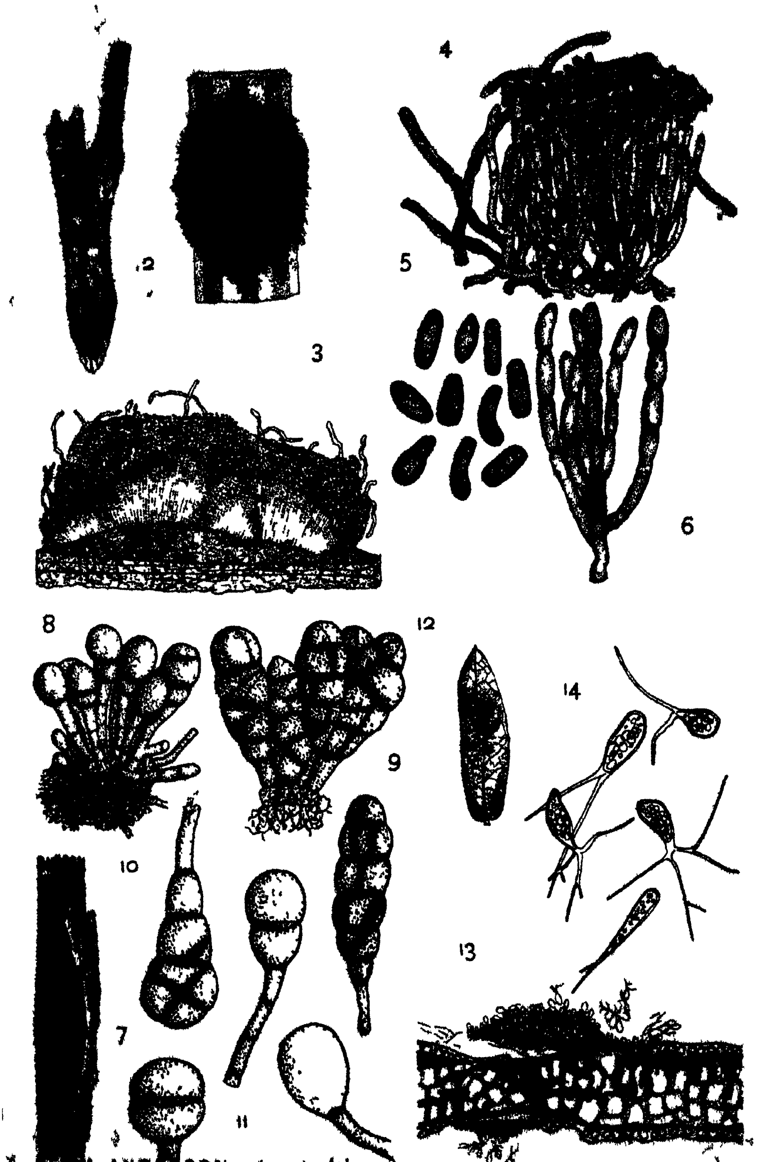
mentose: heads 5–7-flowered, the lower scattered, cernuous, and subtended by lanceolate foliaceous bracts, the upper approximate, subspicate, erect, and with filiform bracts, which are adnate to the bases of the pedicels: involucre cylindric, of 5–7 linear or narrowly oblong, rigid, more or less carinate, acute bracts: pappus a little tawny: lobes of the corolla as long as the throat.—On Mt. Rainier, at 6,500 feet altitude; collected by C. V. Piper, August, 1888.

In *L. hypoleuca* Benth. the throat of the corolla is comparatively long and the teeth short. The proper tube is also short and manifests near the middle a peculiar change of consistence, the lower part being of firmer texture and perceptibly greater diameter than the upper. In L. Piperi the proper tube is long and slender, and is of like texture throughout.

The other plant to be described is a Silene, identical with two unnamed specimens already in the Gray Herbarium from other localities. On investigation it has been found that these plants, while agreeing closely with one another, differ in several significant particulars from any member of the genus yet described, and deserve therefore a place as a new species, the characters being as follows:

Silene Suksdorfii. (Pl. VI, figs. 9–11).—A low cespitose alpine perennial: stems 2–3 inches high, usually simple, 1–3-flowered, minutely pubescent below, glandular above: cauline leaves about two pairs, 3–7 lines long, one line wide, linear, obtuse or acutish; radical leaves numerous, crowded, similar to the cauline or a little spatulate: calyx glandular-pubescent, broadly cylindric, 5 lines high by 3 lines broad, the ten nerves conspicuously anastomosing above, but unbranched below the middle of the tube: petals white, not deeply bifid, the lobes entire or minutely erose, but with no prominent lateral tooth; appendages oblong, retuse: ovary raised on a stipe, which is 1½ lines long.

This species most nearly resembles *S. Grayi* Watson (pl. VI, figs. 7–8) but is distinguished by its lower habit, more stipitate ovary, the shorter untoothed lobes of its petals, and the character of the calyx, since in S. Grayi the nerves of the calyx do not anastomose with each other, but remain quite distinct, as may be seen from fig. 7. Specimens of S. Suksdorfii have been sent to the Gray Herbarium from the following localities in the Cascade Mountains of Washington: Mt. Paddo (Adams), at 7,000–8,000 feet altitude, collected by W.



F. W. ANDERSON, ad nat. del.

Geo May Powell Phila

N. Suksdorf, Aug. 9th, 1882; Mt. Stewart, collected by T. S. Brandegee, Aug. 1883; Mt. Rainier at 8,000 feet altitude, collected by C. V. Piper, Aug. 1888.

Cambridge, Mass., Oct. 1890.

New Species of Montana Fungi.

J. B. ELLIS AND F. W. ANDERSON.

(WITH PLATE VII.)

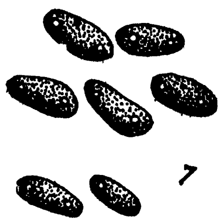
Lentinus pholiotoides.—Cespitose, 2 cm. high, tough and elastic. Pileus convex 1.5–2 cm. diam., appressed pilose-squamose with a few appressed wart-like scales in the disk; color at first yellowish white, becoming subferruginous. Lamellæ sinuate, attached with a decurrent tooth, hardly crowded, 2–2.5 mm. wide, margins acute, minutely fimbriate-serrulate, dull white becoming yellowish, subventricose. Stem mostly curved or crooked, tough, elastic, spongy within, minutely pubescent above, loosely floccose-squamose below, a little paler than the pileus, 2 cm. high, 3 mm. thick. Spores white, oblong, obtuse with an oblique apiculus, 10–14 × 5–6 μ. Basidia 35–40 × 8–10 μ, clavate-cylindrical. Has the aspect of a Pholiota.—On dead Populus tremuloides. Sand Coulee, Montana, May, 1889.

Helotium Montaniense.—Substipitate, pale flesh color, 1–1.5 mm. across, concave with the margin repand and lobed or undulate, rather lighter outside, glabrous and subplicate, contracted into a short stipe about 1 mm. long or nearly sessile. In shape and size about like *Mollisia cinerea* Batsch, but differing in color and in being stipi-

1

2 3 4

tate. Asci clavate-cylindrical, 60–65 × 6–7μ. Paraphyses filiform, gradually but slightly thickened above. Sporidia 1-seriate, elliptical or ovate-elliptical, hyaline, subinequilateral, with a small nucleus in each end, 8–10 × 3–4μ. On decaying sticks and wood in wet places.—Sand Coulee, Cascade co., Montana, May 1889.—Anderson, no. 490.



EXPLANATION OF FIGURES.—1, about natural size, on dead wood; 2, a mature specimen considerably enlarged; 3, a somewhat younger specimen considerably enlarged; 4, vertical section, showing hymenial layer; 5, group of asci and paraphyses in situ; on the side (at 6) a paraphysis peculiarly branched; 7, mature spores. Figs. 5 and 7 much magnified.

Phoma ilicina.—Amphigenous. Perithecia innate, raising the cuticle into little pustules, with the apex suberumpent, globose, small (0.2mm. diam.) Sporules fusoid-oblong, hyaline, 2-nucleate, 6–8 × 2–3μ, on basidia of about the same length as the sporules themselves.—On dead holly leaves (Ilex sp.), Washington, D. C., Oct. 1890.

Coniothyrium ilicinum.—Perithecia epiphyllous, rather prominent, the epidermis blackened over them. Sporules subglobose, or short-elliptical, pale-brown, about 2.5 or 3μ in the longer diameter.—On same leaves as preceding.

Dothiorella Nelumbii.—Perithecia scattered, semi-erumpent, rough, black, pierced above, about 150μ diam., depressed-spherical or sublenticular. Sporules oblong-fusoid, hyaline, 15–22 × 6–7μ. Has the aspect of a Sphærella.—On receptacle of Nelumbium, Washington, D. C., Oct. 1890.

Volutella occidentalis. (Plate VII, figs. 1–6.)—Sporodochia gregarious, thin and flat, about 1 mm. or a little more

in diameter, pale orange or flesh-color, fringed with suberect, pale, roughish, faintly septate hairs 110–150μ long. Conidia cylindrical, straight, hyaline, with a nucleus in each end, 6–8.5$\times$1.5–2μ, concatenate on branched basidia and formed by the constriction of the upper part of these branches (figs. 5 and 6.)—On dead stems of Astragalus flexuosus and A. Drummondii. Sand Coulee, Cascade co., Montana, May 1889.

This is closely allied to *V. gilva* (Pers.) but differs from Saccardo's description of that species and from his figure in F. Ital. 728, in its concatenate, shorter conidia and branching basidia. The specimen of V. gilva in Sydow's Mycotheca Marchica differs from this in its much longer (500μ) brownish hairs and rather narrower (1.5μ) conidia and from the description in Sylloge Fung. in its longer hairs and shorter (6–8μ) conidia.

Var. **minor** differs in its slenderer, smoother hairs and smaller (5–6$\times$1.25–1.5μ) conidia.—On dead Salix.

Sporidesmium sorisporioides.—Forming thin, tobacco-brown, narrow, elongated, sublinear strips or patches, 2–5 cm. or more long, evenly effused and composed of nearly globose cells 12–15μ diam. loosely combined into glomerules (conidia) 25–40μ diam. almost exactly like the spore masses of Sorosporium.—On decaying wood. Montana, June 1889. Anderson, no. 519.

Macrosporium puccinioides. (Plate VII, figs. 7–11.).—Tufts hysteriiform, narrow, 2–3 mm. long, erumpent through longitudinal cracks in the cortex of the stem so as to closely resemble a Puccinia. Hyphæ erect, simple, septate, yellowish-hyaline, 60–70$\times$5μ, densely compacted, at first swollen at the apex, then the swollen part becomes 1-septate and assumes an elliptical or oval shape, 20–30$\times$15–20μ, and finally becomes elongated, oblong or clavate-oblong, 60–70$\times$18–22μ, brown, 3–4-septate and muriform. The resemblance to Puccinia is very striking.—On dead stems of Bigeloviæ? with *Dothidea Montaniensis*, E. & E. Helena, Montana, Nov. 1888. Rev. F. D. Kelsey.

Æcidium Liatridis.—Spermogonia small, epiphyllous, black, on slightly thickened, light colored, sometimes purplish-bordered, elongated spots, 0.5–1 cm. long by 3–4 mm. wide. Æcidia hypophyllous, thickly scattered on the spots, the pseudo-peridia narrow-cylindrical or slightly enlarged above,

two to six times as long as broad, white or slightly pinkish, margin usually irregularly lacerated. Spores subglobose, oblong or ovate, 20–26μ in their longer diameter.—On leaves of Liatris punctata. Great Falls, Montana, July, 1888.

This appears to be the *Æ. Compositarum* Mart. var. *Liatridis* Webber, in his Cat. Fl. Nebr. 1889, p. 70; but the elongated pseudo-peridia seem to distinguish it from any of the forms of Æ. Compositarum. Webber speaks of the pseudo-peridia being very short, so that what he has described may be another thing.

Æcidium Cleomis.—Amphigenous, on brownish, slightly thickened spots. Small, about 0.33 mm. diam. closed at first, then open but scarcely recurved, margin sublacerate. Spores irregularly globose or subovate, 15–20μ diam.—On Cleome integrifolia. Helena, Montana, May, 1887. Anderson, no. 3.

Æcidium Chrysopsidis.—Spots thickened, pale, immarginate, 2.5–5 mm. diam., mostly on one side of the midrib, but sometimes extended entirely across the leaf and longitudinally for 1 cm. or more. Æcidia irregularly scattered or sometimes subconcentrically arranged so as to leave a vacant space in the center, entirely buried, showing at first only as slight mammiform projections, on the surface of the spots, finally, with a round opening above and either without any projecting margin or at most with a very slight and narrow one. Spores yellow, mostly ovate-oblong, 18–23 x 14–16μ. Peridial cells mostly ovate, coarsely cellular, 30–35 x 15–25μ.—On leaves of Chrysopsis villosa. Sand Coulee, Cascade co., Montana, June, 1888.

There is an Æcidium on Gutierrezia Euthamiæ that is very near this if not identical with it.

Pestalozziella Andersoni Ell. and Evrht. (Plate VII, figs. 12–14.).—Acervuli amphigenous, gregarious, not on definite spots, small, convex-hemispherical, black. Sporules ovate-elliptical, hyaline, continuous, with a spreading, sub-3-parted crest of hyaline bristles or threads.—On fading leaves of Apocynum or Asclepias. Sand Coulee, Montana, leg. F. W. Anderson.

Newfield, N. J. and New York City.

EXPLANATION OF PLATE VII.

Fig. 1. *Volutella occidentalis* Ell. and Anders., natural size on dead stems of Astragalus Drummondii; 2, sporodochium of same magnified; 3, vertical section

of sporodochium more highly magnified, showing mass of loose spores and scurfy matter on top, sparingly mixed with the characteristic hairs; 4, a group of basidia with the hairs highly magnified; 6, a branching basidum and loose spores very highly magnified 7, *Macrosporium puccinioides* Ell and Anders., on dead stems of Bigelovia (?) Montana, Kelsey, slightly magnified; 8, a group of forming and young spores rising from the interwoven threads forming the substratum of the sporodochium; 9, a cluster of mature spores; 10, two mature spores showing the stipitate base, 11, three young spores, showing the remarkable resemblance to Puccinia spores. 12, *Pestalozziella Andersoni* Ell. and Evrht , natural size on small leaf of Apocynum cannabinum, 13, vertical section through a leaf showing the destructiveness of the fungus; highly magnified, 14, five spores more highly magnified

A key to the North American genera of the Labiatæ.

ALFRED C. STOKES.

While the keys to this group in Gray's Manual and in other botanies are praiseworthy in many respects, they are not adapted to use in the field, unless that use is to be limited to those who have become experts. To the beginner and the amateur they are disheartening. The following compilation from the Synoptical Flora is in reality Professor Gray's alone; all that I have done is to attempt to use only the more obvious characters that will lead to the genera in the most direct way. That even so limited a paper as this is free from errors is not expected. Notice of blunders will be gladly received from those that may try to use the key.

I. Ovary merely 4-lobed, not deeply 4-parted (A).

II. Ovary deeply 4-parted (B).

III. Ovary deeply 5-lobed; corolla almost regular, 5-parted, blue ....**Isanthus**, 3.

A Stamens exserted from the cleft in the upper lip of the corolla (**b**).

A Stamens not exserted from the cleft in the upper lip of the obscurely bilabiate corolla (**a**).

a Calyx deeply 5-cleft, regular, lobes lanceolate, twice as long as the turbinate tube; corolla nearly salverform.....**Tetraclea**, 1.

a Calyx barely 5-cleft; corolla tube narrow; filaments long exserted.....**Trichostema**, 2.

b Corolla upper lip deeply cleft, the lower declined, lateral lobes united to it....**Teucrium**, 4.

b Corolla upper lip short, truncate; lower lip large, middle lobe emarginate or 2-cleft....**Ajuga**, 5.

B Stamens declined toward or resting on the lower lip (C).

B Stamens not declined (D).

C Disk enlarged into glands; posterior calyx teeth broad, with decurrent often wing-like margins.... **Ocimum, 6.**

C Disk entire or with an anterior gland; calyx not as above.... **Hyptis, 7.**

D Corolla upper lip not galeate, sometimes slightly concave (E).

D Corolla upper lip galeate or concave (1).

E Corolla not strongly bilabiate (F).

E Corolla bilabiate; fertile stamens 2 only (V).

E Corolla bilabiate; fertile stamens 4 (Y).

F Corolla lower lobe large, pendent, fimbriate; stamens straight, long, divergent.... **Collinsonia, 8.**

F Corolla lower lobe spreading, 3-cleft, no bearded ring within (H).

F Corolla about equally 4-lobed, hardly irregular; stamens erect (G).

F Corolla tube broad, lobes 5, broad, plane, rather erect; stamens 4, distant.... **Sphacele, 27.**

G Fertile stamens 4.... **Mentha, 9.**

G Fertile stamens 2; upper corolla lobe entire.... **Lycopus, 10.**

H Stamens distant, straight, never convergent nor curved (I).

H Stamens ascending or arcuate, often converging or parallel (M).

I Fertile stamens 2 only; calyx equally 5-toothed, throat very villous.... **Cunila, 11.**

I Fertile stamens 4; calyx throat naked (J).

I Fertile stamens 4; calyx throat bearded (L).

J Corolla upper lip entire or slightly emarginate (K).

J Corolla upper lip 2-cleft, all the lobes narrow, plane.... **Monardella, 14.**

K Anther cells linear, divaricate.... **Hyssopus, 12.**

K Anther cells parallel.... **Pycnanthemum, 13.**

L Flowers imbricated with broad, colored bracts.... **Origanum, 15.**

L Flowers scattered or crowded, bracts inconspicuous.... **Thymus, 16.**

M Calyx campanulate or short; corolla tube short, or not exceeding the bracts; fertile stamens 4; calyx about 10-nerved, throat naked .... **Satureia, 17.**

M Calyx various, 12 to 15-nerved (N).

N Upper corolla lip plane or slightly concave and straight (O).

N Upper corolla lip concave, erect, straight or a little incurved; calyx 15-nerved (U).

O Style beardless (P).

O Style villous, sometimes sparingly so; stamens sometimes 2 only (T).

P Stamens 4 (Q).

P Stamens 2 (S).

Q Stamens arcuate, shorter than the corolla; calyx about equally 5-toothed.... **Micromeria, 18.**

Q Stamens ascending under the upper lip (R).

R Corolla tube straight, mostly exceeding the calyx; throat commonly enlarged.... **Calamintha, 19.**

R Corolla tube straight, bent backward at the throat, ringent, shorter than the calyx; leaves linear, margins revolute.... **Conradina, 21.**

R Corolla tube declined at base, then ascending, included in the calyx; leaves ovate, serrate.... **Melissa, 20.**

S Fruticulose and canescent; calyx terete and regular; equally 5-toothed or nearly so; corolla mostly with a hairy ring within.... **Poliomintha, 22.**

S Low herbs; calyx usually gibbous, more or less bilabiate or unequally 5-toothed; corolla tube naked.... **Hedeoma, 23.**

T Calyx deeply and unequally 5-cleft, campanulate or turbinate, ciliate, throat naked.... **Pogogyne, 24.**

T Calyx bilabiate, nearly terete, throat villous; leaves linear, entire .... **Ceranthera, 25.**

U Calyx bilabiate, throat naked, teeth acerose-spinulose; stamens inserted high in the ampliate throat, anther cells 2, divaricate.... **Acanthomintha, 26.**

V Calyx bilabiate, lower lip 2-cleft (W).

V Calyx tubular or bilabiate with lower lip 2-toothed (X).

W Corolla upper lip erect, usually concave; stamens on the throat; connective linear or filiform, transverse on the short mostly horizontal filament.... **Salvia, 28.**

W Corolla upper lip spreading; filaments exserted, seemingly simple, anthers linear, 1-celled; calyx deeply cleft as if spathaceous, throat naked.... **Aubertia, 29.**

X Calyx nearly regular, 5-toothed, orifice more or less hirsute.... **Monarda, 30.**

X Calyx bilabiate, throat naked, teeth subulate.... **Blephilia, 31.**

Y Anthers not approximate in pairs, the cells parallel (Z).

Y Anthers more or less approximate in pairs, the cells divergent; filaments not exserted (ZZ).

Z Stamens divergent or distant, exserted.... **Lophanthus, 32.**

Z Stamens parallel, ascending.... **Cedronella, 33.**

ZZ Calyx about equally 5-toothed, throat more or less oblique.... **Nepeta, 34.**

ZZ Calyx upper tooth much larger than the others, throat equal .... **Dracocephalus, 35.**

1 Calyx with a dorsal crest-like projection.... **Scutellaria, 36.**

1 Calyx without a dorsal projection (2)

2 Calyx globular or oblong, barely repand-bilabiate.... **Salizaria, 37.**

2 Calyx deeply bilabiate (3)

2 Calyx not bilabiate, 3 to 5-lobed (4).

2 Calyx not bilabiate, 5 to 10-toothed (5)

3 Filaments of the upper pair 2-toothed at apex, one tooth naked, the other bearing the divaricate-celled anther.... **Brunella, 38.**

3 Filaments simple.... **Brazoria, 39.**

4 Calyx sub-regular, equally 5-toothed; flowers simply opposite in the spikes, one under each bract.... **Physostegia, 40.**

4 Calyx tubular-campanulate, 3-lobed; inflorescence terminal and capitate, 2 or 3 flowers under each bract.... **Macbridea, 41.**

4 Calyx campanulate, inflated, deeply 4-cleft; inflorescence simply and loosely leafy-spicate.... **Synandra, 42.**

5 Stamens included in the short tube, upper lip merely concave; calyx strongly ribbed, teeth 5 to 10, subulate or spinulose; leaves rugose.... **Marrubium, 43.**

5 Stamens ascending beneath the galeate upper lip (6).

6 Stamens not deflexed after anthesis (7).

6 Stamens deflexed to the sides of the throat or contorted after anthesis (10).

7 Calyx turbinate or tubular-campanulate, commonly oblique, filaments not appendaged (9).

7 Calyx tubular (8).

7 Calyx funnelform-dilated at the throat; filaments not appendaged.... **Ballota, 44.**

8 Corolla upper lip strongly galeate; upper pair of stamens appendaged at base.... **Phlomis, 45.**

8 Corolla upper lip erect, or incurved and elongate entire; filaments not appendaged.... **Leonotis, 46.**

9 Leaves cleft or incised, veiny, all longer than the capitate-verticillastrate flowers.... **Leonurus, 47.**

9 Leaves mostly cordate.... **Lamium, 48.**

9 Leaves ovate or oblong-lanceolate; inner valve of each anther-cell hirsute, the other larger, naked.... **Galeopsis, 49.**

10 Calyx tubular-campanulate; corolla tube cylindrical, throat not dilated, upper lip erect.... **Stachys, 50.**

Trenton, N. J.

BRIEFER ARTICLES.

Observations on the new Texas fern *Notholæna Nealleyi* Seaton, as described in "Contributions from the U. S. Herbarium," ii, p. 61, no. 894, June, 1890, and a Mexican fern collected by C. G. Pringle near Gaudalajara in 1888.

The general characters are here shown in parallel columns:

Notholæna Nealleyi Seaton. Type specimens in Nat. Herb.	*Notholæna* sp.? Pringle's no. 1864, in Herb. G. E. D.
Plant 6 to 6½ inches tall. Rootstock cespitose (characterized in original description, l. c., as a slender rhizome), crowns thickly clothed with black subulate scales, slightly pectinate; fronds clustered, stipites 1 to 1½ inches long, terete, or nearly so, *black*, clothed at the base with small reddish-brown scales, above with reddish bristly minute scales and hairs extending upward and along the rachises; laminæ 4 to 5 inches long, 1½ to 2 inches broad, pinnate, oblong-lanceolate, narrowed both ways, upper surface sparingly sprinkled, lower, as well as the rachises and stipites, thickly coated with more or less deciduous *yellowish-white* ceraceous powder. *Sori brown*, continuous round the slightly recurved unchanged margins.	Plant 5 to 14 inches tall. Rootstock cespitose, crowns clothed with black subulate slightly pectinate scales; fronds clustered, stipites 2 to 3 inches long, terete, *brown*, clothed at the base with small reddish-brown scales, above with reddish bristly minute scales and hairs extending upward and along the rachises; laminæ 3 to 11 inches long, 1 to 2¼ inches broad, bi- to tripinnate, oblong-lanceolate, narrowed both ways, upper surface copiously sprinkled, lower, as well as the rachises and stipites thickly coated with *white* ceraceous powder, more or less deciduous; *sori black*, continuous round the slightly recurved unchanged margins.

Special characters noted on comparing two fronds of corresponding size and appearance in age and natural development.

N. Nealleyi Seaton. Frond pinnate, pinnæ sessile, or lowermost sub-sessile, bipinnatifid, or partially pinnated at the base, pinnules deeply lobed, ultimate lobes the largest; texture subcoriaceous, veins visible on looking through toward the light. Stipes and main rachis *black*, secondary rachises blackish beneath, green above and channelled, wing-margined, wings connecting the pinnules; lowermost pinnæ gone but probably somewhat shorter than those above.	*Notholæna* sp.? Pringle's No. 1864. Frond distinctly bipinnate nearly to the top, uppermost pinnæ sub-sessile, lowermost short stalked, pinnules distinct, sessile, deeply lobed and nearly pinnate at the base, ultimate segments the smallest, texture coriaceous, veins obscure. Stipes and main rachis *brownish*, not wing-margined nor channelled above, lowermost pinnæ shorter than those above.

In summing up conclusions from the foregoing observations it appears to be extremely unsafe to separate the two ferns into distinct

species with the present material in hand. The particular differences noted seem to be only of varietal significance and do not seem to warrant disposing of the Mexican fern in any other way than by referring it to the Texan fern as a variety. I therefore name it var. **Mexicana** and have ticketed Mr. Pringle's fern as *Notholæna Nealleyi* Seaton, var. **Mexicana.**

My thanks are due to Dr. Geo. Vasey and Mr. J. N. Rose, of the National Herbarium, for their kindness and courtesy in sending to me for examination the typical specimens of Notholæna Nealleyi.—GEO. E. DAVENPORT, *Medford, Mass.*, December, 1890.

Sarcodes sanguinea.—That this plant is not a root-parasite but a saprophyte, was demonstrated by myself, Dr. Chas. Schäffer, and Col. Hutchings of Yosemite, in 1883, an account of which was the subject of one of my "Contributions." With pick and shovel we carefully surrounded and undermined some plants, and then removed the earth particle by particle from the ball; there was no attachment to host roots, nor were there any roots of any kind in the mass of earth to which they could have been attached. Fearing that the dryish earth might break off some thready matters without our perceiving them, we soaked some of these balls in a pool of water allowing the earth to gradually float away as muddy water, with the same result. But, and this is the point I want to make now, neither was there any decaying vegetable matter such as we usually find around the roots of ordinary saprophytes. After satisfying ourselves that the plant was not a parasite, and that it must be a saprophyte, one was selected in what one might call almost pure sand, but no trace of vegetable matter was apparent to the unaided vision. The plant seems scarcely symbiotic in the proper sense of the term. My own conclusions were that in some unexplained way, the plant was able to draw nitrogenous and other material from the earth without the aid of organs necessary to this end in most cases. What Dr. Oliver calls roots we did not find, —nothing but a spongy looking or coral-like mass of cellular tissue.

Since the pretty speculation regarding the nitrogenic agency of fungi in preparing food for saprophytic plants has been developed, we can detect some of this character by olfactory evidence, which I have found very satisfactory in most cases. This speculation had not been laid before us in 1883, or it would have been tested then,—but the odor of fungi, if any there were, must have been very slight or it would have been noted.—THOMAS MEEHAN, *Philadelphia.*

EDITORIAL.

MOST COLLEGE teachers of botany who are fit for their places would, we doubt not, greatly prefer to have pupils come to them without previous instruction (?) in botany than with the usual sort, which needs first of all eradication. For many of these false ideas the text books are responsible; for many the teachers. Misleading analogies are often suggested in text books, in books for popular reading, in lectures, and now they are appearing in alarming numbers in the bulletins of the agricultural experiment stations. The laudable object is always to make the statements more intelligible; in which object they often fail, and succeed only in implanting faulty conceptions. Two of these misleading analogies will serve as illustrations. No phrase is more common than "stomata, or *breathing*-pores," and it inevitably connects these apertures with respiration, with which they have almost, or quite, nothing to do. As well call the perspiratory ducts of the human skin "breathing-tubes"! The former analogy is as thoroughly false as the latter. Why not say air-pores if we must have an English form? Respiration is already weighted to the last limit with misunderstandings; this millstone ought to be removed from its neck. "Spores *i. e.*, bodies that are like seeds in use" — does that analogy illuminate or obscure? The writer from whom this is taken was speaking of conidia, which are much more "like" cuttings or slips in use than like seeds. But why compare at all seeds and spores, mycelium and roots, conidiophores and peduncles? Why not let it be understood from the outset that the fungi are not comparable with the phanerogams? Their structure is simple enough to be understood if described without comparison. When analogy in function is predicated, inferences of similarity in structure, wrong as they may be, are made unconsciously when one object is well known and the other wholly unknown. Examples might be multiplied. Let the teacher in the class-room, before an audience, and in popular bulletins scrupulously avoid misleading analogies.

CURRENT LITERATURE.

Adaptations to Pollination.[1]

This is a continuation of a work published in 1888 as Heft No. 10 of the Bibliotheca Botanica, and noticed in the *Gazette*, xiii, 134. The

[1] AUGUST SCHULZ —Beitræge zur Kenntniss der Bestæubungseinrichtungen und Geschlechtsvertheilung bei den Pflanzen, Vol. II. Bibliotheca Botanica, Heft no. 17, I & II. Cassel: Theodor Fischer, 1890.

observations recorded in this volume were made in middle Germany and in the lower and higher regions of the Tyrol, in the years 1886–1888. 171 pages are devoted to a consideration of the adaptations of different flowers, which are taken up in their natural order, there being 187 species belonging to thirty-eight families. After many of the larger families there are summaries of the results. Pages 172–224 are devoted to several topics which the author has reserved for special consideration. Thus on pages 203-224 the author gives a list of perforated flowers which he found in two years, 1887-'8, stating the position of the perforations and the insects which make them. The list contains about 160 flowers, 125 of them being perforated by a single species of bumble-bee, Bombus terrestris.—R.

The Missouri Botanic Garden.

A hand-book of the Missouri Botanical Garden has just been issued, which in a very handsome and elaborate way gives the objects of the Garden and School of Botany, and the principal steps which have thus far been taken to forward them. The book contains 165 pages and is issued under the editorial supervision of Dr. Trelease. There are numerous handsome illustrations and a large scale map of the Garden. In addition to the presentation of the facts of organization and plans of work the book contains Mr. Thomas Dimmock's biographical sketch of Mr. Henry Shaw; Mr. Shaw's will; Dr. Trelease's inaugural address; the first annual "flower sermon" by the Rt. Rev. Daniel S. Tuttle, Bishop of Missouri; and the speeches at the first annual banquet.

Minor Notices.

THAT IMPORTANT WORK, *Die Natürlichen Pflanzenfamilien*, has now reached lieferung 54, which contains a continuation of Compositæ by Hoffman. The genera are brought up to Achillea, which is no. 545. The North American genera are very much as Dr. Gray left them, and American work in general has been adopted. This may be explained in some cases by lack of material for verification.

PART II of the Proceedings of Philadelphia Academy of Science for 1890 has been distributed and contains the following botanical titles: Descriptions of three new species of Myxomycetes, with notes on other forms in Century XXV of the N. A. F., by *Geo. A. Rex;* New N. Am. Fungi, by *J. B. Ellis and B. M. Everhart;* and Contributions to the life-histories of plants, No. 5, by *Thos. Meehan.* The contents of Mr. Meehan's contribution have been noted in this journal (xv. 345).

MESSRS. LAZENBY AND WERNER, of the Ohio State University, have published a supplementary list to the Beardslee catalogue of Ohio

plants. This supplement is put out to give information as to the plants that have been discovered in Ohio since 1874, and also to call forth additional information preparatory to the publication of a complete revised catalogue. The supplement adds 177 species of Phanerogams.

THOSE WHO are interested in the relation of flowers and insects will welcome the list of books, memoirs, etc., on the fertilization of flowers for the period 1883-9, a continuation of the list published in 1883 by D'Arcy Thompson.[1] Such bibliographies are of great value and Mr. J. MacLeod has placed the workers in this field under obligations.

OPEN LETTERS.

Mounting plants.

The recent excellent note of Theo. Holm on this subject prompts me to say a few words, more especially in regard to mounting grasses. In the collection at our college the plants are held to the sheets by means of stout strips of gummed paper, often a quarter of an inch wide, or even more for securing heavy specimens. It has recently been my privilege to turn over nearly all the grasses in the herbarium of Harvard University, where they are secured to the sheets by means of glue. If well done, and the plants are not too thick and heavy, and not sent to and fro by mail or express, the glue holds the smaller, thinner specimens very well, but those with heavy culms or rootstocks spring loose in many cases, and then are usually to be "patched up" by pasting on gummed strips. The glue process would tend to prevent theft of small fragments or spikelets of valuable specimens, but it also makes it difficult to turn over or partially over a spikelet or leaf blade or sheath to observe a ligule or other part not mounted right-side out. Quite frequently specimens mounted in this way are considerably disfigured by surplus glue, and patches of the coarse paper upon which the specimen was placed while the glue was applied are left sticking here and there, like morbid tufts of a peculiar pubescence. For working specimens of grasses and sedges and similar plants, my experience leads me to favor decidedly the method of pasting by means of strips of paper. Happily, there is a rapidly growing tendency among botanists of our country to collect, preserve, and mount specimens which are more complete than those usually put up by the older botanists of a generation or two ago. Such collectors as Pringle, whose specimens have found their way into the herbaria of many botanists, have served to stimulate better work. There is another thing which does not yet receive the attention it deserves, viz.: the collecting and preservation of surplus flowers, fruits, seeds, spikelets, etc., loosely placed on most sheets and held by an envelope or folder. This whole subject with an abundance of illustrations would be an admirable one for some thorough and neat enthusiast to present to the botanical club of A. A. A. S. or even to the section of biology.—W. J. BEAL, *Agricultural College, Mich.*

---

[1] Separately printed from the Botanisch Jaarboek, tweede Jaargang (1890) pp. 195-254.

NOTES AND NEWS.

PROF. DR. W. P. WILSON has recently been elected a member of the German Botanical Society.

R. V. WETTSTEIN shows by the intermediate stages that each of the staminodes of Parnassia palustris represents a single stamen.

THOUVENIN after an exhaustive study of the Saxifragaceæ says that there is not a single anatomical character which is constant.

PROF. DR. H. MUELLER-THURGAU of Geisenheim has been appointed director of the German-Swiss experiment station and school for fruit, wine, and garden culture at Wädensweil near Zürich.

AN OLD LETTER of Persoon's is published in the *Am. Naturalist* (Dec.) It was found in a copy of Persoon's "Synopsis Methodica Fungorum," recently purchased for the University of Nebraska.

PROF. FRANK finds Robinia Pseudacacia capable of utilizing free nitrogen, like the other Leguminosæ. In the roots of four plants 125 days old were 0.092 gm. of N, as against 0.0024 gm. in the seed sowed.

PROF. DR. JULIUS WORTMANN of Strassburg assumed the directorship of the plant physiological station at Geisenheim on February 1. The station is a department of the royal institute of fruit and wine culture.

A NEW GENUS of Uredineæ, Barclayella, is described by Dr. Dietel in a late number of *Hedwigia* (XXIX, p. 266). It is related to Chrysomyxa and Coleosporium. Only teleutospores are known. The single species described occurs in the western Himalayas, parasitic upon spruce.

HUGO DE VRIES has succeeded in obtaining for several successive years an increasing number of sterile plants of maize by sowing grain from the most poorly productive plants. He concludes, therefore, that sterility in the case under consideration is a hereditary quality susceptible of fixation.

THE *Journal of Botany* quotes some botany that has found its way into fiction (The Village Blacksmith). It is good enough to bear repetition. "The garden had been neglected . . . his roses had reverted to type, and bore suckers of bramble and large-eyed roses." This reversion to type took place in a couple of months or so.

MR. C. G. PRINGLE'S last season's collection is being determined at Cambridge, preparatory to the distribution of sets. The work was pushed farther south than ever before, and, as a consequence, the collection contains an unusual number of novelties. As soon as the sets of 1890 are distributed Mr. Pringle intends to return to Mexico.

THE EDITORS and publishers of the *Botanisches Centralblatt* announce the commencement of a series of supplements to the journal in order to allow earlier and fuller abstracts of new works. These supplements will each contain 80 pp. and seven will appear annually, increasing the size about one-third. The additional cost to subscribers to the journal will be only *M.* 10.50.

THE MOSSES collected by Dr. Julius Röll along the N. P. R. R. in 1888 were distributed to different bryologists for study, Brotherus, Müller, Venturi, Cardot, Renauld, and Barnes. From their reports diagnoses of 24 new species and 20 new subspecies and varieties are published in the *Bot. Centralblatt*, xliv, 385–391 and 417–424. The full reports are to be published later.

THE *Gardeners' Chronicle* has just celebrated its jubilee, its first number having appeared January 12, 1841. The founders were Dr. Lindley and Sir Joseph Paxton. It is to be congratulated upon its long and eminent list of contributors and upon its constantly increasing usefulness. It is one of those gardening journals that have become a necessity not only to the practical gardener but to the professional botanist as well.

A STRANGE FUNGUS from Madagascar is described and figured in the *Journal of Botany* (Jan.) by George Massee. It consists of a stem-axis bearing distinct pilei which are acropetal in development. "The stem is erect, tapering upwards, and bearing several superposed circular pilei separated by elongated internodes, and becoming smaller upwards." It becomes 6 to 9 cm. high, has been taken as the type of a new genus, and bears the name *Mycodendron paradoxa*.

IN A DESCRIPTIVE LIST of Ranunculaceæ from western North America, J. Freyn in the *Deutsche bot. Monatsschrift* for last December (viii, p. 176) describes a blue form of wind flower from Washington as *Anemone cyanea*, which seems to be closely like, if not identical with, *A. Oregana* of Gray. He also distinguishes variety *strigulosus* of *Ranunculus reptans* from Oregon, and raises the British American form, *R. aquatilis*, var. *heterophyllus* Torr. & Gr., to the dignity of a species under the name *R. Grayanus*.

MARCEL BRANDZA has made a somewhat extended study of the anatomical characters of hybrids. Some of the peculiarities he figures (in the Revue gén. de Bot., vol. ii,) are very striking. His general conclusions are as follows: 1. Certain hybrids present in their structure a combination of the special characters found separately in the parents. 2. In other cases the structure of the different parts of the hybrid is, for all tissues, simply intermediate between the two parents. 3. Other hybrids have in certain organs an intermediate structure and in other organs a structure combining the anatomical peculiarities of the parents.

M. GASTON BONNIER began some time ago a series of experimental cultures of various plants at different altitudes in the Alps and Pyrenees (from 740 to 2400 m.) to determine the effect of Alpine conditions. He presents (Rev. gén. de Bot., ii, 513) the results of this work so far as they relate to the *facies* of the plants. As compared with plants grown in lowlands, the stature is very small; the internodes are very short; the subterranean parts are relatively much more dèveloped; the leaves are very small and both relatively and absolutely thicker and of a darker green color; and the flowers are of more vivid hues. In a future paper he promises to show that both structure and function are correspondingly modified. The illustrations show the changes in size very strikingly.

DOULIOT concludes after studying a number of plants belonging to diverse families "that in the very large majority of Dicotyledons the stem is terminated by three initial cells, and in a small number of others by two initial cells only, in which case one initial is common to the bark and central cylinder. In the Monocotyledons the case of two initial cells is more frequent. In the Gymnosperms the stem has a single initial cell at its apex. The fact of having a single apical cell, together with the presence of the archegonium, allies the Gymnosperms more closely with the Cryptogams, but the presence of an independent epidermis, a common and exclusive character of both Di- and Monocotyledons, serves to connect these two groups with the Gymnosperms."—Cf. Ann. Sci. Nat. Bot., ii, 283–350.

GREENERIA FULIGINEA, which causes the bitter rot of grapes, is not to be confounded with Coniothyrium Diplodiella or Tubercularia acinorum, according to the studies of F. Cavara (Atti Inst. bot. Univ. di Pavia, ser. II, i, p. 359; abs. in Centralblatt f. Bak. u. Parasit., viii, p. 810). Instead of belonging to the Sphæropsideæ, it goes to the Melanconieæ and to Saccardo's section Phæosporeæ. The genus characters of Melanconium agree completely with those of Greeneria. C. therefore proposes to place the fungus under that genus with the following diagnosis: *Melanconium fuligineum* (Scribner & Viala) Cavara. Acervulis sparsis griseo-cinereis, epidermide tectis, dein in fissuris ellipticis erumpentibus; conidiis continuis, ovoideis vel ellipsoideis utrinque acutiusculis, dilute fuligineis, in muco atro immersis, stromate parenchymatico conoideo, albido, suffultis, $7.5–9 \times 4–4.5 \mu$.

OSCAR EBERDT sets forth (Prings. Jahrb. für wiss. Bot., xxii, 293) his observations on the formation of starch grains, which differ from the well known ones of Schimper on the function and destiny of the leucoplasts. It would seem from his investigations that there is differentiated from the plasma certain bodies of small size and of proteid-like material which he designates as "Stärke-Grundsubstanz"—*pro-amyloid*—because they act as the basis for the formation of the grain. These are bordered or surrounded by a covering of plasma. The first starch recognizable by the iodine test appears in the proamyloid which diminishes as the grain and the plasma coat increases. The grain presently enlarges sufficiently to break through the plasma coat which then remains as a cap. The grain continues to grow as long as this cap is present. After it is lost no more growth is possible. Grains so formed will be excentric. Concentric grains are formed inside a plasma coat which they do not rupture. Stratification does not appear until the grain breaks or is freed from the plasma. It is, according to Eberdt, only the plasma coat or cap which can properly be called the starch former. The proamyloid is passive. Eberdt controverts the view that the leucoplasts may be converted into chloroplasts under the influence of light.

VOL. XVI. NO. 3.—BOTANICAL GAZETTE.—MAR., 1891.

Black rust of cotton: a preliminary note.[1]

GEO. F. ATKINSON.

Early in the past season I began a study of the fungous diseases of the cotton plant with the special object to determine the disease called "black rust." The first of August, 1890, one hundred circular letters were sent to different farmers of Alabama requesting specimens of "black rust," "red rust," "Frenching," "root rot," etc. As it seemed probable that there was some confusion in the application of these names to certain appearances of the cotton a special request was made of the senders to carefully label the plants with the name applied by them to the disease.

From twenty-five to thirty replies were received including specimens marked "black rust," "red rust," and "root rot."[2]

The disease has been very prevalent and destructive during the season and excellent opportunities were afforded me for studying it in the vicinity of Auburn, not only upon the station farm but on neighboring plantations.

July 22d, on one of my visits to the cotton field, I found the disease had made its appearance in full force in several spots, where fully one-half of the leaves of the plants had fallen off, the remainder being curled, dried, and blackened by a profuse development of dark hyphæ and spores of several fungi, so that by suddenly jarring a leaf the spores would float off in clouds like the smut spores of some of the Ustilagineæ. Some of the plants showed still the earlier stages of the disease, and in other parts of the field were numerous opportunities to study the earlier stages. For two months my time was occupied in noting the external characters, collecting material, examining the different fungi found and noting the relation of each species to the variety of external characters presented in the progress of the disease.

---

[1] Paper read before the American Association of Agricultural Colleges and Experiment Stations, Champaign, Ill., Nov., 1890

[2] The "root rot" disease was reported from only one place The effects of the disease upon the plant are strikingly similar to those produced by the Texas disease which is caused by *Ozonium* according to Pammel, but due to an entirely different organism, a nematode worm, *Heterodera radicicola.*

The fungi commonly present and which play an important part in the disease are *Cercospora Gossypina* Cooke, a species of *Colletotrichium*,[1] a *Macrosporium*,[2] an *Alternaria*, and frequently a pycnidial stage of some sphæriaceous fungus,[3] and a bacterial organism which produces a characteristic disease of the leaves.

The bacterial disease is often very widely spread even when no evidences of the other fungi are to be found, but is mentioned here because frequently it is an accompaniment of the "black rust" and contributes materially to the aggravation of the disease. It is first manifested by a watery appearance in definite areolate spots which are bounded by the veinlets of the leaf. The spots are sometimes very numerous and frequently conjoined; often the disease follows one or more of the main ribs of the leaf being bounded on each side by an irregularly zigzag line. As the disease ages the spots become blackish and finally brown, frequently then bordered by a blackish color where the disease has extended somewhat centrifugally. The disease hastens the falling off of the leaves.

During the entire season, from July to the close of October, of the thousands of leaves old and young that I have examined, Cercospora Gossypina has been an almost universal accompaniment, and has not been second in point of attack, except perhaps in rare cases. In many cases parallel or immediately succeeding attacks were made by the Colletotrichium. The Macrosporium as a rule follows closely the attack of the Cercospora,[4] indeed sometimes seeming to be the first to attack. In such cases possibly it attacked the spots diseased by Cercospora before the hyphæ and conidia of the latter were developed. The Alternaria usually succeeds the Macrosporium, though often seeming to be parallel with it. By its numerous clusters of hyphæ and profusely developed concate-

---

[1] *C. Gossypii* E A Southworth

[2] This seems to be an undescribed species for which I have proposed the name *Macrosporium nigricantium*. The hyphæ are amphigenous, subfasciculate or scattered .050-.140 mm. long × .006-.007 mm. in diameter, nodulose, septate, olive brown Conidia 018-022 mm × 036-050 mm, strongly constricted about the middle, stoutly rostrate at one side of the apex, smooth, transversely longitudinally and obliquely septate, olive brown The nodulose hyphæ resemble those of such species as *M parasiticum* Thuem

[3] This is probably *Phyllosticta Gossypina* E. & M Some recent cultures in agar-peptone broth and an infusion of cotton leaves seem to show that it is the pycnidial stage of an undescribed *Pleospora* which I have found on cotton leaves.

[4] Possibly also that of the Phyllosticta.

nate spores in favorable weather the leaf is soon covered with a mass of spores giving a blackened appearance to the leaves.

My correspondents in Alabama use the term "black rust" when the disease progresses very rapidly and the development of the hyphæ of Cercospora and setæ of Colletotrichium, or the Macrosporium and Alternaria spores, is very profuse causing the leaves to appear black. When the disease progresses more slowly, being checked by unfavorable weather, or is in the first stages, the term "red rust" is used. In such cases the Macrosporium or Alternaria has extended centrifugally the spots attacked by the Cercospora, increasing their size, causing them to become more nearly circular, and marking the spots with concentric lines. Also the edges of the leaf are dead and dried, and curled either below or upward, being favorite places for the attack of either the Cercospora or Colletotrichium. The body of the leaf is still green, paled by different shades of a dull yellow or dull purple.

In some cases in the early stages of the disease the Colletotrichium severely attacks the upper part of the stem of the plant and petioles of the leaves giving the stems a dark color from the internal changes, to the leaves a scalded appearance and causing them to shrivel and dry up much as if frost-bitten.

Sometimes the development of Cercospora may be so great and the attack of the other fungi so tardy as to give the appearance of "black rust" produced by it alone. Specimens of this kind were received from one of my correspondents at Eutaw, Ala. The conditions for the development of Cercospora were so favorable that from one-fourth to three-fourths of the leaf surface was covered with a dense mass of the dark brown hyphæ, the remaining portion of the leaf being yellowish with numerous small points of attack. The hyphæ and conidia in such cases are very long, often five to eight times as long as described by Cooke. Specimens collected at a later date at this place gave an abundance of the Macrosporium and Alternaria.

Where other fungi, as Colletotrichium, Macrosporium and Alternaria are abundant, it is often very difficult to find the Cercospora on the leaf. By placing the leaves, freshly gathered, in moist chambers for ten or twelve hours I have never failed to get an abundance of Cercospora, even on the smallest, uppermost leaves of the plant. Sometimes the Macrosporium

is the predominating fungus in the last stages of the disease giving a black appearance to the entire leaf.

Much speculation in agricultural papers has been indulged in regarding the cause of "black rust" of cotton. It is not proposed in this preliminary note to critically examine the various theories propounded. Some of my correspondents who formerly attributed the disease to the peculiar condition of the soil, lack of fertilizers, etc., say that sometimes in the best soil and with careful fertilizing the disease appears in a very destructive form. That has been abundantly proven during the past year under my own observation. Cercospora, Colletotrichium and Phyllosticta are all active parasites, and I am convinced from a year's study that Cercospora Gossypina is a more active and destructive parasite than has been formerly regarded. A diseased condition once started by such a fungus opens the way for the rapid growth and great injury produced by such forms as Macrosporium and Alternaria. It is possible the Macrosporium may infect the leaves unaided by other fungi. Inoculations of plants free from other forms must be made to determine this.

Cercospora Gossypina sometimes produces a serious spot disease of the cotyledons. I first observed this on some young plants started on the horticultural grounds, in September, for experimental purposes. I am told that sometimes in cold seasons in May this spot disease is quite injurious along with "sore shin."

While in North and South Carolina my attention was called to a disease termed "red rust" which was chiefly characterized by a reddening of the leaves not produced nor accompanied by any fungous growth. In most cases this seems to be due to some condition of the soil which induces a hastened maturity of the plant and the development of erythrophyll in the cell sap of the leaves. In some cases the development of erythrophyll is induced by the irritation of mites as I have proved by infection experiments. From several places in both states cotton quite severely injured by mites has been sent me. An account of this was published in Bulletin no. 4 of the South Carolina Agricultural Experiment Station, January, 1889.

The reddening of the leaves by the development of erythrophyll in the cell sap of the leaves is very common in some soils in Alabama and probably in all the cotton-producing states. It is quite possible that all through this belt there

are those who term this the "red rust," but so far as I have been able to learn by talking with farmers in Alabama, and from the specimens received, the term here is applied to the early, or arrested stages of "black rust" as I have described above.

Auburn, Ala.

Flowers and insects. VI.

CHARLES ROBERTSON.

Triosteum perfoliatum L.—In the bud the style is bent and the stigma is pressed against the opposing lobes of the corolla. As soon as the lobes separate the style straightens and the stigma is thrust out. The stigma rises from 3 to 4 mm. above the anthers and appears to be receptive while they are still indehiscent, so I regard the flower as proterogynous. The corolla continues to lengthen until the second stage. In this stage the anthers are dehiscent, and the stigma is turned to one side. The flowers are rather dark purple and collected in inconspicuous clusters in the axils of the perfoliate leaves. Nectar is secreted in a gibbosity in the base of the corolla. The corolla is from 14 to 16 mm. long and is adapted to long-tongued bees.

Visitors: (May 18 and 23) *Apidae:* (1) Bombus Ridingsii Cr. ♀, s.; (2) B. vagans Sm. ♀, s., visited all of the open flowers and forced its proboscis into several buds, whose lobes had hardly begun to loosen, but which contained an abundance of nectar; (3) B. americanorum F. ♀, s.; (4) Anthophora abrupta Say ♂, s,; *Andrenidae:* (6) Augochlora pura Say ♀, s. and c. p., crawls into the tube; (7) Halictus Lerouxii St. Farg. ♀, c. p.

Cephalanthus occidentalis L.—The first peculiarity of the flower that strikes one is the great difference in the height of the anthers and stigma. Indeed, it looks like a long-styled dimorphous flower. The anthers are at the mouth of the tubular corolla, while the stigma rises 7 mm. higher. It looks as if the pollen could never touch the same part of the insect which comes in contact with the stigma. The disparity is accounted for by the fact that the style itself serves to expose pollen to the visitors. In the bud the anthers dehisce, depositing all of

their pollen in a conical mass upon the summit of the style. The style rises to its usual height and holds the pollen where it will easily touch insects lighting upon the globular head of flowers. After the pollen has been removed, the stigma becomes receptive, and the flower is now in the second or female stage.

Meehan[1] has taken the loading of the pollen upon the tip of the style as a plain case of self-fertilization. But it is no more a case of self-fertilization than the loading of pollen upon the style brush of Campanula. As far as they go, Meehan's observations do not support the view that self-fertilization occurs even in absence of insects, for he says: "Numerous seeds are in every head examined. Carefully dissecting one, I found it had 279 flowers, of these 225 perfected seeds, and only 54 failed." He had made the gratuitous assumption that fullness of fruit is evidence of self fertilization.[2] As between cross and self fertilization, the 225 fruitful cases prove nothing; the failure of one in five flowers is presumptive evidence against the power to self-fertilize.

The round heads of white flowers are very attractive to insects. The corolla tubes are 9 mm. long and are very narrow, especially below. The flowers are thus adapted to long and thin tongues. The nectar rises in the tube so that shorter tongued insects can reach some of it, but the predominant visitors are butterflies. On 11 days, between July 5th and August 17th, I observed the following visitors:—

Hymenoptera — *Apidae:* (1) Apis mellifica L. ☿, s., ab.; (2) Bombus virginicus Oliv. ☿, s. and c. p., freq.; (3) B. separatus Cr. ♂♀☿, s., ab.; (4) B. Ridingsii Cr. ♂, s., one; (5) B. americanorum F. ♂♀☿, s. and c. p., ab.; (6) B. pennsylvanicus De Geer, ♀☿, s., freq.; (7) B. scutellaris Cr. ☿, s., one; (8) Emphor bombiformis Cr. ♀, s., one; (9) Xenoglossa pruinosa Say ♂, s.; (10) Melissodes obliqua Say ♀, s.; (11) M. bimaculata St. Farg. ♂, s.; (12) Ceratina dupla Say ♀, s.; (13) Megachile mendica Cr. ♀, c. p.; (14) Nomada texana Cr. ♀, s.; *Andrenidae:* (15) Halictus Lerouxii St. Farg. ♀, s., one; (16) H. ligatus Say ♀, s., one; (17) Agapostemon nigricornis F. ♀, s.; (18) A. radiatus Say ♂, s.; (19) A. texanus Cr. ♀, s.; (20) Prosopis affinis Sm. ♀, f. p.; *Pompilidae:* (21) Priocnemis ful-

[1]Contributions to the Life Histories of Plants. Proc Acad. Nat Sci. Phila., 1887, 323-333; 4 figs See also Bull. Torr. Bot. Club, xv, 54.

[2] Bot. Gazette xiii, 157.

vicornis Cr., s., one; *Scoliidae:* (22) Myzine sexcincta F. s., one.

Lepidoptera—*Rhopalocera:* (23) Papilio philenor L.; (24) P. asterias F., ab.; (25) P. troilus L.; (26) Pieris protodice Bd.-Lec.; (27) P. rapae L.; (28) Colias caesonia Stoll; (29) C. philodice Godt.; (30) Danais archippus F. ab.; (31) Argynnis cybele F.; (32) Phyciodes tharos Dru.; (33) Pyrameis atalanta L., ab.; (34) P. huntera F.; (35) P. cardui L.; (36) Limenitis disippus Godt.; (37) Satyrus alope F.; (38) Thecla humuli Harr.; (39) Chrysophanus thoe Bd.-Lec., ab.; (40) Lycaena pseudargiolus Bd.-Lec.; (41) L. comyntas Godt.; (42) Pamphila zabulon Bd.-Lec.; (43) P. huron Edw.; (44) P. peckius Kby.; (45) P. cernes Bd.-Lec.; (46) P. delaware Edw.; (47) Nisoniades juvenalis F.; (48) Eudamus tityrus F., ab.; *Arctiidae:* (49) Utetheisa bella L.; *Pyralidae:* (50) Scepsis fulvicollis Hübn.—all s.

Diptera—*Conopidae:* (51) Physocephala tibialis Say, s.; *Syrphidae:* (52) Sphaerophoria cylindrica Say, s.; (53) Volucella evecta Walk., s.; (54) Eristalis tenax L., s., ab.; (55) E. latifrons Lw., s. and f. p.; (56) Syritta pipiens L., s.; *Muscidae:* (57) Musca domestica L., f. p.

Coleoptera—*Coccinellidae:* (58) Hippodamea 15-maculata Muls., f, p.; *Scarabaeidae:* (59) Trichius piger F., f. p.

Hemiptera—*Lygalidae:* (60) Oncopeltes fasciatus Dall., s.

Lobelia[1] *spicata* Lam.—In my neighborhood this is the earliest blooming Lobelia. The plants are scattered and are neither so attractive to insects nor so easily observed as the next species. The flowers are white and are arranged in rather loose spikes. They are proterandrous, like the other species which have been observed. The corolla tube is 4–6 mm. long, and the nectar is therefore only readily accessible to tongues of medium length.

Visitors: (5 days, May 31 to June 12) Hymenoptera—*Apidae:* (1) Ceratina dupla Say ♀; (2) Megachile brevis Say ♀; (3) Alcidamea producta Cr. ♀.

Lepidoptera—*Rhopalocera:* (4) Pieris protodice Bd.-Lec.; (5) P. rapae L.; (6) Chrysophanus thoe Bd.-Lec.; (7) Ancyloxypha numitor F.; (8) Pamphila peckius Kby.; (9) P. cernes Bd.-Lec.—all s.

Lobelia leptostachys A. DC.—Resembles L. spicata, but the spikes are more conspicuous, and the corolla tubes are a

[1]On the fertilization of Lobelia see Mueller: Fertilization of Flowers, 365, 633.

little longer. On account of later blooming, the list shows less of the genus Melissodes and an increase in Megachile.

Visitors: (7 days, July 8 to 31) Hymenoptera—*Apidae:* (1) Apis mellifica L. ☿, s.; (2) Bombus separatus Cr. ☿, s.; (3) B. americanorum F. ☿, s.; (4) Melissodes obliqua Say ♂, s.; (5) M. bimaculata St. Farg. ♂, s; (6) Ceratina dupla Say ♀, s.; (7) Megachile rufimanus Rob. (MS) ♂, s.; (8) M. brevis Say ♂♀, s. and c. p.; (9) M. petulans Cr. ♂, s.; (10) M. exilis Cr. ♂, s.; (11) Anthidium emarginatum Say ♂♀, s.; (12) Andronicus cylindricus Cr. ♀, s.; (13) Coclioxys 8-dentata Say ♂, s.; *Andrenidae:* (14) Agapostemon nigricornis F. ♀, s.; (15) Augochlora pura Say ♂♀, s., the male sucking through the slit in corolla; (16) Halictus fasciatus Nyl. ♂, s.; (17) H. pilosus Sm. ♀, c. p.

Lepidoptera—*Rhopalocera:* (18) Lycaena comyntas Godt.; (19) Pamphila cernes Bd.-Lec.; (20) Nisoniades juvenalis F.—all s.

Diptera—*Bombylidae:* (21) Systoechus vulgaris Lw., s.

Lobelia syphilitica L.—The large blue flowers are specially adapted to bumble-bees. Delpino saw it visited by Bombus italicus and B. terrestris. In this country Trelease[1] saw it visited by several species of Bombus. As intruders he observed Osmia sp. and Ceratina dupla Say ♀ collecting pollen.

Visitors: (4 days, Aug. 12 to Sept. 3) *Apidae:* (1) Bombus separatus Cr. ♀, s.; (2) B. virginicus Oliv. ☿. s. and c. p.; (3) B. vagans Sm. ☿, s. and c. p.; (4) B. americanorum F. ♀☿, s., ab.; *Andrenidae:* (5) Augochlora pura Say ♀; (6) Halictus connexus Cr. ♀—both collecting pollen which they work out of the anther-tube with their jaws and front feet.

Lepidoptera—*Rhopalocera:* (7) Danais archippus F.; (8) Papilio philenor L.—both s.

Lobelia cardinalis L.—Trelease (*l. c.*) saw this flower visited by humming-birds, Trochilus colubris L. I have never failed to find them about the flowers, and there is no doubt that the flowers are specially adapted to them. The pendant lip shows that the flower is intended to be visited by a bird or insect which is in the habit of sucking the sweets from flowers without resting upon them. I have also seen the flowers visited by Papilio philenor L. and P. troilus L.

On two occasions I counted five individuals of Bombus americanorum F. ☿, about the flowers. Sometimes one of

[1] On the fertilization of several species of Lobelia, Am. Nat. xiii, 427–432.

them would try to reach the nectar in front, but failing, would crawl down to the base of the flower and insert its tongue through the slit, but most of them only tried to reach the nectar through the slit. This is the only time I have seen a bumble-bee obtaining nectar illegitimately.

Augochlora pura and Halictus connexus also visit this plant for pollen, behaving as on the flowers of L. syphilitica.

Since the flowers of Lobelia are intended to be visited by insects entering below the stamen tube it is an imperfection that the tube has openings between the bases of the upper filaments, for this allows improper visitors to steal the nectar through the slits in the upper side of the corolla. Trelease saw Augochlora pura treating flowers of L. erinus in this way and I have observed the same thing in L. leptostachys and L. cardinalis.

Lobelia cardinalis × *syphilitica.*—Very many plants of the two preceding species grew together in a large patch. The ruby-throated humming-bird passed by L. syphilitica and only visited L. cardinalis. The bumble-bees visited L. syphilitica regularly, only stealing the nectar of L. cardinalis in the cases indicated; and they might not have done so, if they had not been drawn among them by L. syphilitica.

The insects which occurred on both species and which effect hybridization are Bombus americanorum, Augochlora pura, Halictus connexus and Papilio philenor.

Among the plants I found nine specimens of the hybrid. The corolla is shorter and broader and the lobes shorter and firmer than in L. cardinalis, and is described by Schneck[1] as of a deep reddish or crimson-purple. There is abundant nectar, but the others seem imperfect.

Twice I saw Bombus americanorum visit the flowers in the regular way, showing that it could reach the nectar easily. This led me to wonder if the humming-bird would visit the hybrid. Seeing one alight upon a limb over my head, I drew back and was rewarded by seeing him come down and visit the hybrid along with L. cardinalis. It was interesting to observe that, while Bombus americanorum could not suck the nectar of L. cardinalis properly and humming-birds did not visit L. syphilitica at all, the nectar of the hybrid was easily accessible to the one and its colors were attractive to the other.

[1]Bot. Gaz iii, 35

Campanula Americana L.[1]—In the GAZETTE, xiii, 225, I have observed that this flower is in the first stage of irregularity, and that bees land upon the style and insert their tongues between the bases of the upper stamens. But, although the stigma is turned so as to strike the ventral surface of the bee, the stamens still retain the useless habit of covering the style on all sides with pollen. At first the style is straight so that the bee touches only the upper side, but afterwards it bends so that the bee may touch the sides and even the underside near the tip. But still much pollen is wasted by being fixed on the lower side. Megachile exilis, which visits the flower for pollen, regularly turns and hangs under the style so as to clean the pollen off the lower side. This is another illustration of the fact that in dichogamous flowers, which as a rule are only properly visited for nectar, the pollen often acts disadvantageously by attracting insects which remove it and neglect the flowers in the female stage.

The larger bees, which are the only insects adapted to the flower, visit it only for nectar and only touch the upper side of the style. I repeat the list given in the GAZETTE, l. c., with some additions.

Visitors: (11 days, July 10 to Aug. 28) Hymenoptera—*Apidae:* (1) Apis mellifica L. ☿; (2) Bombus virginicus Oliv. ♂☿; (3) B. separatus Cr. ♂; (4) B. americanorum F. ♂☿; (5) Melissodes bimaculata St. Farg. ♂♀; (6) Megachile brevis Say ♂☿—all sucking; (7) M. exilis Cr. ♂♀, s. and c. p.; *Andrenidae:* (8) Agapostemon radiatus Say ♂♀, s; (9) Augochlora pura Say ♀, c. p.; (10) Halictus Lerouxii St. Farg. ♂, s.; (11) H. coriaceus Sm. ♂♀, s; (12) Prosopis affinis Sm. ♀, f. p.; *Spccidae:* (13) Ammophila sp. searching for nectar; *Scoliidae:* (14) Myzine sexcincta F. s.

Lepidoptera—*Rhopalocera:* (15) Pyrameis cardui L. s.; (16) Pholisara hayhurstii Edw., s.

Apocynum[2] *cannabinum* L.—The flowers are white, much smaller than in A. androsæmifolium, and the nectar is lodged in rather shallow receptacles, so that flies and other short-lipped insects can reach it. A. androsæmifolium, according to Ludwig, is visited by butterflies and cements its pollen to their tongues. I have found the pollen-masses of this species on the maxillary and labial palpi of bees, and but

---

[1]See Barnes: Bot Gaz. x, 349, pl. x and vol. xi, 99

[2]On literature of genus see Mueller: Fertilization of Flowers, 396, 631.

rarely on other parts of their tongue. The insects in the list are marked m. l. or t. according as the pollen masses were found on the maxillary or labial palpi, or on the ligula proper.

Visitors: (June 21, 25) Hymenoptera—*Apidæ:* (1) Apis mellifica L. ☿, l.; (2) Coelioxys 8-dentata Say ♂♀; (3) Stelis lateralis Cr. ♀; (4) Nomada articulata Sm. ♂, m. l.; (5) N. incerta Cr. ♀, m. l.; *Andrenidæ:* (6) Macropis steironemæ Rob. (MS) ♂♀; (7) Agapostemon radiatus Say ♀, m.; (8) Augochlora lucidula Sm. ♀; (9) Halictus fasciatus Nyl. ♀; (10) H. connexus Cr. ♂♀; (11) Colletes sp. ♂, m.; (12) Prosopis affinis Sm. ♀; *Eumenidæ:* (13) Odynerus foraminatus Sauss. t.; *Bembecidæ:* (14) Monedula ventralis Say; *Larridæ:* (15) Astata bicolor Say; *Sphecidæ:* (16) Ammophila vulgaris Cr.; (17) Isodontia philadelphica St. Farg., t.; (18) Priononyx thomæ F., (19) P. atrata St. Farg.

Diptera– *Mycetophilidæ:* (20) Sciara sp.; *Bombylidæ:* (21) Anthrax alternata Say; *Syrphidæ:* (22) Allograpta obliqua Say; (23) Sphærophoria cylindrica Say; (24) Tropidia mamillata Lw.; (25) T. quadrata Say; *Empidæ:* (26) Empis sp.; *Tachinidæ:* (27) Cistogaster divisa Lw.; (28) Ocyptera sp.; (29) Jurinia apicifera Walk.; (30) Micropalpus sp.; (31) Acroglossa hesperidarum Will.; *Sarcophagidæ:* (32) Sarcophaga sp.; *Muscidæ:* (33) Lucilia caesar L.; (34) L. macellaria F.; *Anthomyidæ:* (35) Anthomyia sp.; (36) Limnophora sp.

Lepidoptera—*Rhopalocera:* (37) Argynnis cybele F.; (38) Thecla calanus Hübn

Coleoptera - *Scarabaeidae:* (39) Trichius piger F.

Hemiptera—*Capsidae:* (40) Lygus pratensis L.; *Lygaeidae:* (41) Lygæus turcicus F., s.

Carlinville, Ill.

Notes on technique. II.

JAMES ELLIS HUMPHREY.

In the study of zoospores, especially those of Fungi, it is not always easy to demonstrate clearly the number and attachment of the cilia. The iodine preparations usually recommended for that purpose have not proved satisfactory with me on account of their tendency to shrivel and distort the body of the

zoöspore. In some cases, too, they have not acted with sufficient promptness to fix the spore at precisely the right instant. In view of these facts attempts have been made to find a more satisfactory method of treatment, and I have adopted after numerous trials a combination somewhat different from any which I have seen suggested, though it involves nothing new in principle.

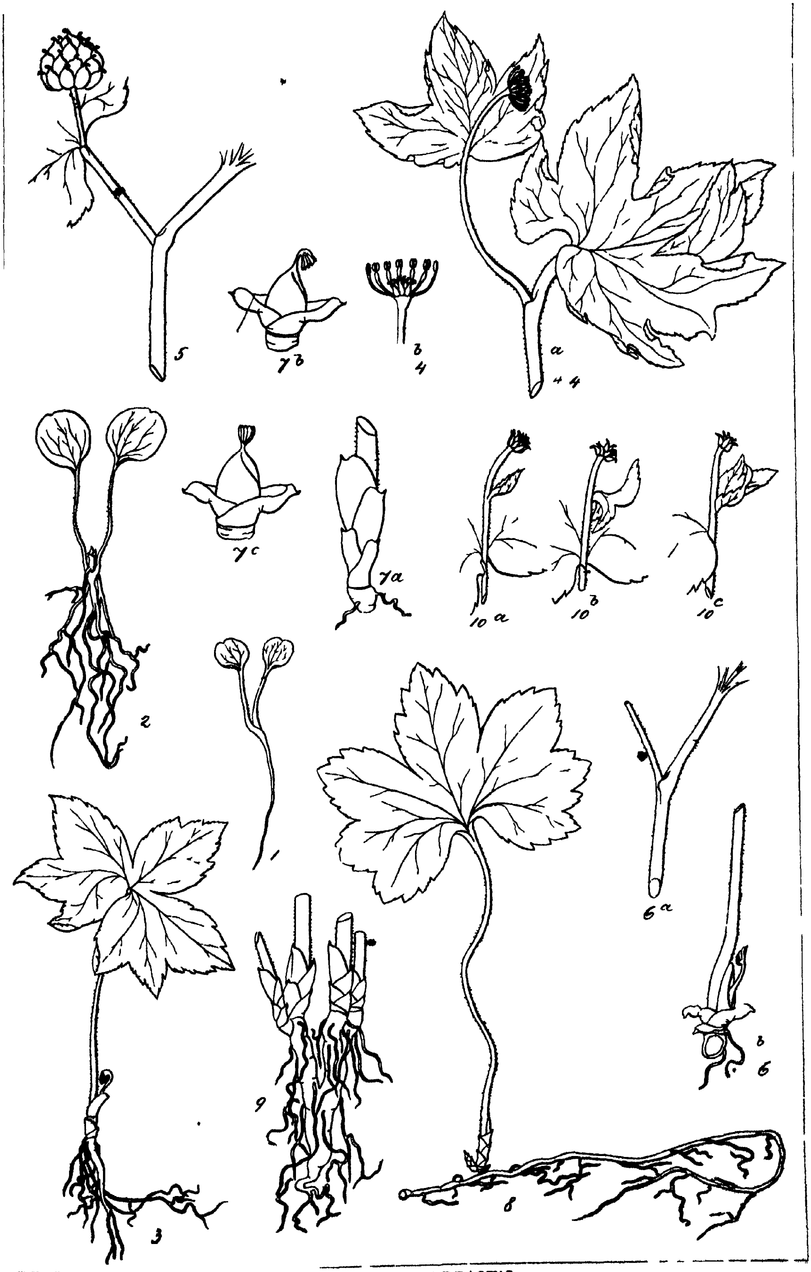
The zoöspores, in water under a supported cover-glass, are instantly killed by placing at the edge of the cover a couple of drops of a one per cent. solution of osmic acid. This is left for a few minutes to fix the spores thoroughly, which it does without the least distortion, and is then drawn off by means of filter-paper. It is not necessary to wholly remove the acid or to pass water under the cover before applying the staining fluid, which consists of a drop of a moderately strong solution in 90 per cent. alcohol of Hanstein's rosanilin-violet, composed of equal parts of fuchsin and methyl-violet. This stains the cilia and the bodies of the zoöspores of both Algae and Fungi very quickly and deeply, as well as sharply, showing the number and insertion of the cilia as plainly as a drawing, and giving a clear image with the camera lucida.

It is very possible that other stains would serve equally well, but I have not taken time nor has it seemed worth while to seek further in view of the uniformly good results obtained as described. For killing and fixing, I think there is nothing quite so good in all respects as osmic acid.

By means of the above treatment I have had no difficulty in demonstrating the correctness of the statements of Cornu[1] and Hartog[2] that the zoöspores of *Achlya* are ciliate, at least in some cases, when they escape from the zoösporangium, as are those of *Saprolegnia*. This statement is directly opposed to those of other writers and to those of the leading text-books,[3] which state that the zoöspores of *Achlya* escape from the sporangium *without cilia*. My observations were made on a form related closely to *A. polyandra* (perhaps that species), and seem to me entirely conclusive. The discussion of the details of the structure of the zoöspores and of the bearings of the fact stated is reserved for a future occasion; but it

---

[1] Ann. Sci. Nat. ser. 5, tom. xv, p. 1.
[2] Quart. Journ. Mic. Sci. vol. xxvii, p. 427.
[3] Cf. De Bary: *Vergl. Morphol. u. Biol. d. Pilze*, p. 116, and Engl. transl. p. 108; Zopf· *Die Pilze*, p. 294.



BOWERS on HYDRASTIS

may be remarked here, as has been done by the previous writers, that the establishment of the diplanetism of *Achlya* brings it much closer to *Saprolegnia*. Indeed the structural differences between them become reduced to a single one; namely, that while in *Achlya* the sporangia formed from a filament arise after the first one by lateral outgrowth below the basal walls of the previous ones, in *Saprolegnia* they usually arise inside of the preceding ones by the upward growth of the successive basal walls. But I have seen, in an undetermined species of *Saprolegnia*, the formation of secondary sporangia after the *Achlya* type on a few filaments. There remain to be noticed two physiological differences so closely connected as to constitute, perhaps, a single phenomenon. The first swarming period in *Achlya* is reduced to its lowest terms, and at its close the zoospores become aggregated into a hollow sphere at the mouth of the sporangium, in response to an apparent mutual attraction which Hartog[1] has termed adelphotaxy. Is this mutual attraction the cause of the shortness of the first swarming period?

Amherst, Mass.

A contribution to the life history of Hydrastis Canadensis.

HOMER BOWERS.

(WITH PLATE VIII.)

About ten years ago while engaged in the cultivation of various indigenous plants and the study of their germination and growth some deviations were observed in the behavior of Hydrastis Canadensis so at variance with the accepted view of the life history, that a minute study of all its peculiarities was begun and from that time to the present it has been followed with the view of bringing the facts to the attention of botanists.

My attention was first drawn to the plant specially, on discovering a stage in its growth concerning which no record exists. Afterwards when investigation disclosed that this unknown stage embraces a feature anomalous in the growth of plants, a great incentive for further research was added. This at length brought to light two other important facts

[1]Annals of Botany, vol. ii, no. vi, p. 216

that seem never to have been noticed, besides several minor points that are unrecorded, together with some slight errors of observation or description. The proper statement of these facts necessitates an account of the life history.

SYNOPSIS OF THE LIFE HISTORY.—Hydrastis Canadensis is a perennial herb found growing in patches in rich open hilly woods, and on the slopes along the wooded bluffs and secondary banks of streams. The seed naturally sown after the ripening of the fruit in July or August, does not germinate until the following spring, about the last week in April, or the first in May. The plantlet consists of a pair of orbicular cotyledons on long spreading petioles, joined to a slender radicle, and makes no further advance in growth the first year of its life, other than the development of the cotyledons, together with the attached radicle, surmounted by a large bud. The seed-leaves alone do duty for foliage during the whole growing period of this stage of its existence.[1]

The second year it sends up a single rounded, palmately-lobed leaf on a footstalk articulated at the root. This stage often persists through the third year; the plant then sends up a larger radical leaf, with perhaps one or more smaller ones in addition.

The third or fourth year the stem arises 15 to 30 or more cm. high, having two alternate leaves, with two-ranked arrangement, the lower larger and petioled, the upper sessile at the junction of the peduncle of the flower with the stem of the plant.

It has thus three stages of growth, being acaulescent for two or more years, and bearing fruit the third or fourth year. The bud-scales found at the base of the stem are two-ranked, conduplicate, and equitant. Under certain conditions it propagates itself by adventitious buds from fibrous roots. There are also evident stipules.

DETAILED DESCRIPTION.—*First stage, duration one year.*—The cotyledons on first appearing are bright emerald green, glossy, oval, about 5 mm. broad and 6 mm. long. The petioles are long and somewhat thickened; the radicle long and slender. The cotyledons attain their full size in about three

---

[1] Rarely, in a very vigorous seedling, a small radical leaf on a short footstalk will be sent up late in June or early in July, and also in a few instances where seedlings have been transplanted at an early stage to a more favorable location, a small radical leaf has been observed to spring up.

weeks, when they measure 8 to 12 mm. in diameter. In general outline they are now orbicular, and slightly emarginate, with three basal nerves, well defined on the under surface, and of a dull green color. The petioles are now long, slender, slightly pubescent, somewhat divergent, and joined to the radicle 6 to 12 mm. below the surface.

In August or September, after the first stage of growth has been completed, the plant consists of the following parts: A few fibrous roots at irregular intervals along a thickened and tapering radicle, from the summit of which a small yellow bud arises about 4 mm. in height; and the two foliaceous cotyledons, showing evidence of maturity and decline, with their petioles inserted at its base.

Second stage, duration one or two years.—The rootstock is small, erect, somewhat conical, and continuous with what constituted the radicle of the first year, which gives off several fibrous roots. There is no stem as yet, and the single leaf is round-cordate, sometimes partially peltate, palmately five-lobed, doubly serrate, with a cup-like depression at base, sits horizontally on a footstalk 5 to 15 cm. long that is articulated on the rootstalk, and has evident stipules.

Third stage, duration indefinite.—The rhizome is knotty, variously contorted, erect, with many long fibrous roots of a bright orange color. The stem arises from a terminal bud 15 to 30 cm. or more high, 4 to 6 mm. in diameter, erect, round, more or less pubescent, yellow below the surface, becoming purplish from the point of exposure to light a short distance upward. Three and sometimes four bud-scales embrace the base of the stem, the inner much the largest. They are conduplicate, equitant, strongly keeled, hooded, mucronate, 10 to 15-nerved, the lateral margins membranaceous. They arise from nodes 4 to 6 mm. apart, and are yellow, becoming purplish if exposed at the surface, and are homologous with stipules. The leaves are now two, rarely three, alternate, with two-ranked arrangement, and plicate vernation. The lower leaf is the larger, 15 to 30 cm. in lateral diameter when mature, with five acute ovate-lanceolate lobes well-defined by deep incisions. The sinuses are always well rounded at the bottom, never acute, though often narrow; the lobes mostly overlap each other and two lateral ones bear one or more minor lobes on their lower borders. The general outline is between reniform and cordate; the basal sinus is very narrow,

the margins often overlap to some extent and occasionally unite for a short distance, thus making the leaf partially peltate.

In all cases a cup-like depression exists at the insertion of the leaf-blade. The petiole is 2.5 to 7.5cm. long, roundish, thick, swelling at the base and amplexicaul, with small tubercular stipules visible at an early age. The petiole and stem both diverge at their point of junction, giving the appearance of a bifurcate stem. The upper leaf is smaller, sessile at the junction of the peduncle of the flower with the stem, and partly clasping. The absence of the leaf-stalk in the smaller, combined with the angle of insertion of both blades, causes the leaves to occupy the same horizontal plane. The third leaf, when present, is much smaller, often distorted, always sessile on the peduncle, and possibly should be regarded as a bract. The flower is white, with a diameter of 12 to 18 mm., solitary, erect, terminal, on a peduncle 12 to 25 mm. long, with 3 or 4 orbicular, concave, green or purplish, caducous sepals, and no petals.

The stamens are 50 to 75, spreading, curving outward and upward, the pure white filaments gradually dilated from the base outward and somewhat contracted near the summit. The anthers are pale straw-color, adnate, with lateral longitudinal dehiscence. The 10 to 20 or more pistils are in a head, with white flat broadly two-lipped stigmas, the lips thin, rounded, and wavy-margined. The style is straw-colored, short and thick, being simply a contraction of the upper part of the ovary. The olive-green oval ovary is somewhat gibbous, sparingly pubescent, sulcate along the whole ventral aspect and the upper third of the dorsal, 1-celled and 2-ovuled. The red fruit resembles a raspberry and ripens in July or August. It consists of an aggregation of fleshy carpels, forming a globular head, each carpel bearing at summit the persistent style which is strongly inclines toward its dorsal aspect. The one or two seeds are small, about 2 by 3 mm. ovoid, black, hard and polished, anatropous, pendulous, with ventral rhaphe, fleshy albumen, and minute embryo.

GENERAL OBSERVATIONS.—The anomalous behavior of this plant in its first stage of growth has escaped observation, partly, I suppose, on account of its retiring habits. It always grows in patches in secluded and shady spots, where the earth is carpeted with decaying leaves; often beside rotting logs, where

the roots are mulched by the decaying wood. The seed-leaves being small and often lying almost flat on the surface, would be observed only by chance; even then there would be nothing in their appearance to connect them with the plant under consideration, unless removed from the earth, when the root by its bright yellow color might indicate the relationship to Hydrastis.

In germination the cotyledons often arise from the earth separated by an interval of 2mm. or more and sometimes one cotyledon will show itself a day or so before the other one appears. If from any cause the cotyledons are destroyed early in summer the lemon-tinted bud does not grow until the following spring. Usually four different kinds of buds are found on an old plant, viz. large winter buds of two kinds, terminal and axillary; small latent buds, with scales but slightly developed; and adventitious buds that are formed on root fibers under certain conditions.

The winter buds of Hydrastis are large and deserving of special study, not only as illustrating the perfect protection that is so often provided for the tender parts during hibernation, but also as furnishing an excellent example in the morphology of leaves, the scales being homologous with stipules. The terminal bud is the largest, and developes the fruiting stem. The axillary bud produces a radical leaf; or, as often occurs, remains dormant for a time. The arrangement of the scales of a terminal bud at the close of the growing season, when the plant has fully completed the preparation for its period of rest, is such that but one, the outer, is truly equitant, the others, each in turn, completely overlapping and enfolding by their hooded and membranaceous expansions the inner till the young shoot itself is enshrouded by the last one.

On removing the scales at this period the young shoot is found to be large; the plicate foldings of the leaves are easily discovered, but the flower-bud is larger than all the rest, the stem being merely a conical eminence upon which the other parts sit. Yet the stipulate amplexicaul base of the petiole is visible, joined to the leaf, seemingly without the intervention of a leafstalk. The sessile leaf is very small indeed, entirely overshadowed by the comparatively enormous flower-bud whose sepals can easily be counted, and the stamens plainly observed.

Stipuliform appendages are not a feature of the order *Ranun-*

culaceæ, but Hydrastis has evident stipules, to be seen in the small tubercles, or points, projecting backward and upward from the amplexicaul petiole of the lower leaf of a fertile stem; and more plainly still at the base of the footstalk of a radical leaf, where they will be found, in early summer, incurved or overlapping each other and always enshrouded by the accompanying bud-scale. Later, when growth has ceased and the old bud-scales have decayed, there will be found, emerging from the overlapping stipules of, a radical leaf, an abortive leaf on a short and rudimentary petiole, with a fully developed stipulate base, which enwraps another smaller one, and so on till the full complement necessary to the formation of a hibernaculum is present. Then, when the old radical leaf has served its time and is overtaken by decay there will be seen, for a short time, tipping the outer scales of the hibernaculum which sprung from its axil, instead of a mucronation, the depauperate leaf raised on a short and tapering footstalk but a few millimeters in height. Sometimes the depauperate leaf appears surmounting the inner scales of a terminal, or the outer scales of an axillary bud, as a digitate or merely fimbriate attachment without the intervention of a foot stalk. This soon perishes, and nothing will be found, after the bud-scale has expanded in the spring, but the blackened mucro, the remains of the footstalk of a depauperate radical leaf, thus plainly demonstrating that the winter bud-scales of Hydrastis are the homologues of stipules.

The development of a radical leaf without an offshoot, or caudex, from a bud in the axil of the lower bud-scale of a fertile stem of the same season's growth often occurs. The planes of insertion of the scales of a new bud are always at right-angles to the plane of the one from whose axil it sprung. Buds are formed in increasing numbers as each year passes, until as many as 20, or, even to 60 fertile stems may be found arising from one rhizome of from six to ten years age, together with a greatly varying number of sterile stems, or radical leaves, ranging from none at all in some cases, to perhaps twenty in others. Among almost every cluster from an old rootstock there will be found one or more stems bearing three leaves. After the annual decay of the stem there is left a cup-like depression at the summit of the caudex.

The persistence of these depressions, each for a few seasons, has given the plant one of its common names "golden

seal." The rootstock is not horizontal, as represented in the drawings of all who have described the plant previously, and if ever found so it is an accident of growth, as I shall proceed to show. Development of rhizome begins with the second year, by the gradual thickening of the head of the primary fibrous root, or radicle. It is difficult to determine at this stage just where the rhizome ends and the root begins. The hibernacula are produced, after the second year, from short offshoots which spring from the axils of previous bud-scales, the offshoots being of such length only as to permit the bud to assume the erect position. The contortion or contraction produced in the rhizome by the decay of some of the offshoots each year is almost always in such manner as to cause the hibernacula to assume a more erect position, one in fact almost continuous with the older part of the rootstock. Thus a perpendicular axis is generally maintained. From this habit of growth an old rhizome is a knotty subdivided mass and presents no regularity of outline. The young rhizome, and the offshoots of the older ones, are marked by slight annular ridges, the sites of former bud-scales. It seems to be a law of development with this plant, that two or more years are required for the perfecting of a terminal bud and its supporting caudex. An old rootstock is abundantly supplied with fibrous roots. These, from their manner of growth and other characteristics, are found to be of two kinds, unequally apportioned. Those most numerous incline downward in their growth and have a length varying from 10 to 20 cm. the others are few in number, and larger, each measuring 20 to 50 cm. or more in length, with a diameter of 1 to 1.5 mm. and growing in a horizontal direction at a depth of 2.5 to 5 cm.

These large fibers under certain conditions sparingly produce adventitious buds, from each of which one or more small radical leaves arise on footstalks. These leaves are identical with the foliage of the second stage of growth from the seed. Three of these buds have been observed on a single large fiber at intervals of 7.5 cm. or more. They seemed to be formed only on those fibers that have been severed from the rootstock without greatly disturbing their distal extremities. Adventitious buds may occur upon the large fibers while yet attached to the rhizome, but if such is the case I have never yet observed it, the budding fiber always being found detached from the plant, with the proximal extremity blackened for a short

distance by incipient decay. Young plants have not been observed to produce budding roots. The leaves have five lobes. Many books give seven, but all over five are as a rule minor lobes whose ribs spring, posteriorly, from the two inferior basal veins. The veins are very prominent on the lower surface and there is a considerable linear depression on the upper surface, in their track. This gives the leaf at the time of flowering, when it is but slightly developed, a very rugose appearance, which persists for some time. The plant puts forth very early, and before the forest is fully clothed in leaves it has attained almost its full development in all points save the expansion and ripening of the fruit, and the maturing of its underground structures. This energy for the first few days is mostly expended in the growth of the stem, which arches over and bends itself as it is extended from the caudex, bursting asunder the bud-scales, which have begun to enlarge rapidly, the inner one especially developing beyond the others. The stem, thus bent, emerges from the earth often 5 cm. or more before the top is dragged forth. Sometimes it happens, when the ground is hard and dry, that it fails to extricate itself, and therefore perishes. The leaves are but slightly developed when the flower appears, which occurs almost immediately after the stem assumes the erect position. The flower lasts five or six days. In a dry season the plant dies down soon after the ripening of the fruit, and by late September the top has disappeared. Again when the season is more moist it will persist even to the beginning of winter.

The fruit when ripe is readily detached from the stem, and has a shallow depression at its base. It is insipid to the taste, non-poisonous, and is eaten by birds, by which means the seeds are disseminated. From various causes but few of the seeds naturally sown ever germinate, and the extension by adventitious buds forming on the root fibers is very slow, as this mode of propagation does not seem to be as well established with this plant as it is with some others.

It would seem from present indications, that the time when Hydrastis will be no longer found in our forests is almost at hand. Possibly its total extinction could never have occurred from the settling and clearing up of the country only, since the natural terraces of many inaccessible ravines, bluffs and mountain sides, where the material best suited for its sustenance had accumulated for centuries, would have been its

impregnable strongholds. But the drafts made upon it in pharmacy to supply the growing demand of the medical profession have set upon it that impecunious class, the "sang" and "puccoon" diggers, who have almost exterminated it in many of those regions where it grew in great abundance.

It may yet be found from the Mississippi river to the Alleghenies, as far north as Canada and to Tennessee on the south, with a limited area of distribution beyond the Mississippi, in Missouri and Arkansas[1]. Over most of this territory it is now so thinned out that its collection is not the commercial success it formerly was. The above boundaries very nearly mark the extent of the distribution it had attained on the earth's surface in its most flourishing time.

But, in this region of central Indiana, within the area of its former natural abundance, I have demonstrated by experiments of some years' duration, that it can be successfully grown by giving it as far as possible the surroundings that it had in the pioneer days of the country. It endures close association with but few other herbs, yet the shade afforded by many of the shrubs and forest trees, if not too dense, seems to be a requirement essential to its perfect growth and development. The grasses are its deadly enemies, and ground that is trodden will not support it. Under such conditions it quickly perishes. A single large plant, removed from the woods to a suitable situation, I have observed in several instances to spread so that an area of five or six feet in diameter would be occupied in eight or ten years time, without any artificial aid, save the keeping in subjection of all other encroaching plants.

Individual characteristics are noted, as marking with more or less variation each group or patch of plants, indicating, that though Hydrastis is a recluse among plants, and presents some deviations that are remarkable, yet this one feature which it possesses in common with most representatives of the vegetable kingdom, may lead through judicious selection and the careful study of its habits of growth, to the establishment, in time, of new varieties. This possibility the following observations of three district patches, originating from plants obtained from different points, and grown on my grounds, seem to show:

[1] Lloyd's Drugs and Medicines of North America, vol. 1, no. 3, pl IX.

Patch no. 1, short: stems 15 to 20 cm.: peduncle short, 6 to 12 mm.: fruit almost sessile on some; carpels 12 to 18: leaves rugose, much incised resulting in many minor lobes, though but five basal veins: color of stems mostly green, slightly purple at base.

Patch no. 2, medium: stems 25 to 30 cm., purplish from base ⅓ of height: peduncles 18 to 25 mm.: carpels few: leaves coarsely serrate, minor lobes rare, scarcely pubescent, large, many of them 30 cm. across.

Patch no. 3, tall: stems 30 to 37.5 cm. purplish from base ⅔ of height: peduncles 35 mm.: carpels 25 to 30: leaves slightly rugose, lateral diameter of lower leaves 25 to 30 cm., minutely pubescent.

New Ross, Indiana.

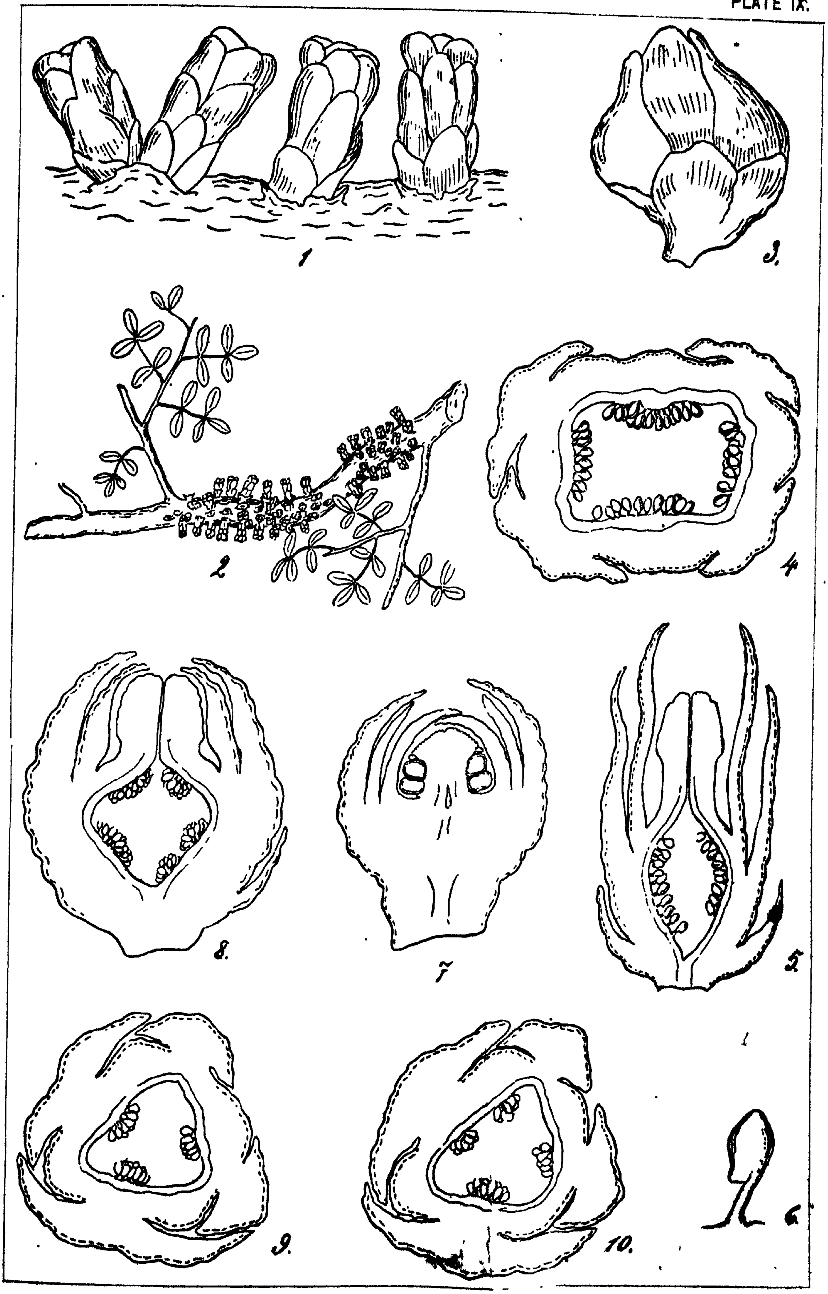
EXPLANATION OF PLATE VIII —Fig 1, seedling 2 or 3 days after germination Fig 2, seedling at the end of the first season's growth Fig 3, second year from the seed Fig 4, *a*, top of flowering plant early in May, stipular eminences plainly shown at base of lower leaf, *b*, flower with most of the stamens removed. Fig 5, part of stem with fruit, late in July Fig 6, stipules; *a*, part of fertile stem with amplexicaul petiole of lower leaf, showing tubercular stipules; *b*, caudex with portion of radical leaf petiole, old bud-scales dissected back and showing stipules at base enveloping the rudimentary hibernaculum, depauperate leaf protruding, as observed in June Fig 7, stipules as bud-scales, *a*, bud-scales at base of fertile stem, early in May, *b* and *c*, buds formed in the axil of a radical leaf, as they appear in October or November with outer scales dissected back, *b*, one of the bud-scales surmounted by a depauperate leaf, *c*, same with merely fimbriate attachment, Fig 8, horizontal root fiber, with adventitious bud and radical leaf Fig 9, rhizome with most of the fibrous roots removed, showing perpendicular character of axis Fig 10, series showing transition from floral bract to leaf, as sometimes observed in exceptional cases where third leaves are produced, *a*, part of upper portion of stem showing attachment of sessile leaf, floral bract, and fruit soon after anthesis, *b* and *c*, same with bracts more leaf-like

Two undescribed species of Apodanthes.

B. L. ROBINSON.

(WITH PLATE IX.)

It is now more than twenty-five years since the discovery, in western Arizona, of *Pilostyles Thurberi* Gray, a diminutive parasite which, notwithstanding great disparity in size, is nearly related to the famous Rafflesia of India. Although the genus Pilostyles, or more correctly, Apodanthes § Pilostyles, is well represented in South America, the rare A. Thur-



ROBINSON on APODANTHES

beri has until lately been its only known North American species. Among the many discoveries made by Mr. C. G. Pringle, however, two new members from northern Mexico have been added to the genus; and specimens of these interesting plants (nos. 1949, and 1950 of Pringle's *Plantae Mexicanae*) have recently been distributed as *Apodanthes Pringlei* Watson, and *A. globosa* Watson. Owing to the diminutive size of the plants in question, their study entailed methods not generally necessary in the systematic examination of phanerogams, and the publication of descriptions of the new species has been much delayed. At the suggestion of Dr. Watson, however, the writer has lately made a microscopic examination of the material in the Gray Herbarium, and presents, as a result, the following descriptions, which are as full as the limited stages of development represented permit.

Apodanthes Pringlei Watson. — Flowers densely crowded cylindric, becoming ovoid, one and one-half lines long, aromatic; bracts and divisions of the floral envelope twelve to fifteen, erect, very unequal in length, imbricated in three (or four) obscurely defined series, ovate to oblong, obtuse, entire or minutely erose, dull brown, the innermost yellowish at the ends: ovary inferior or nearly so, usually quadrangular in cross-section, and with four distinct though rather broad placentæ; style well developed, fully half as long as the ovary; stigma ovoid, umbonate on the slightly produced non-stigmatic apex; fruit broadly ovoid, two lines long, one and one-half lines in diameter, covered with the closely appressed bracts: staminate flowers unknown.—Occurs upon small woody branches of *Dalea frutescens* Gray; collected by C. G. Pringle in the Sierra Madre near Monterey, June 27, 1888.

The placentation of this species shows more or less variability, not only in different flowers, but even at different heights in the same ovary. In most cases a cross-section directed through the middle of the ovary shows (as in fig. 4) the placentæ in a regular relation to the surrounding bracts. In other instances, however, no such correspondence is apparent, and the placentæ are not even symmetrical in relation to each other.

Apodanthes globosa Watson.— Expanded flowers and fruit unknown: buds scattered, globose, two-thirds to one line in diameter; bracts and divisions of the floral envelope eleven to

thirteen, subequal, in three distinct decussate series, broadly ovate to orbicular, minutely erose, thickish, transversely roughened on the outer surface, very dark and shining purple: in the staminate flowers the anthers about thirty, globose, sessile, borne in two crowded rows upon the shaft of the staminal column, of which the upper expanded portion is convex, and minutely papillose over its entire surface, the papillae upon the edges being slightly more prominent; a rudimentary ovary (?) is represented by a narrow central cavity in the base of the column: in the pistillate flowers ovary inferior, three to four angled, but with no regular placentæ, the ovules being distributed in small isolated groups over the entire inner surface; style scarcely any, the stigma large, hemispherical, umbonate.—Occurs on small branches of *Bauhinia lunarioides* Gray; collected by C. G. Pringle in the Sierra Madre near Monterey, June 30, 1888.

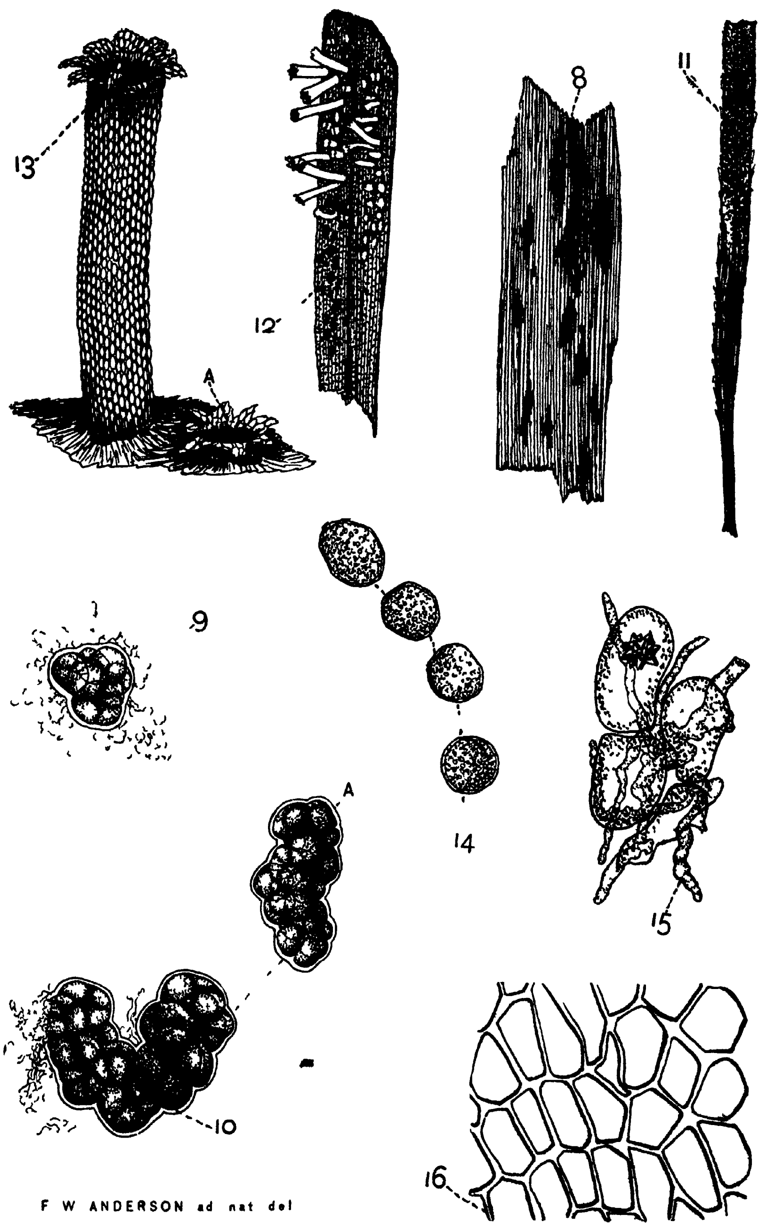
This species considerably resembles in size and form *A. Blanchetii* Gard. of Brazil, also parasitic on a Bauhinia. In the latter, however, the bracts are described as fimbriate-ciliate on the margins, while in A. globosa they are at most minutely erose. Furthermore the ovules of A. Blanchetii, according to Sir Joseph Hooker,[1] are crowded over the whole surface of the ovary, while in A. globosa they occur in rather small isolated groups. The single staminate flower of A. globosa, which was found in the material investigated, occurred upon the same branch with many pistillate flowers. Although a considerable number of flowers of A. Pringlei were examined, all proved to be fertile. The "thallus" of A. Pringlei, investigated by cutting sections of the infested branches of Dalea, appears at the time of flowering to consist of dense, isolated, more or less wedge-formed masses of tissue, extending not only through the cortex but to a considerable depth along the medullary rays into the woody tissue of the host.

Cambridge, Mass., Nov., 1890.

EXPLANATION OF PLATE IX — *Apodanthes Pringlei* Watson — Fig 2 represents the habit of the parasite as it occurs upon the host plant, fig 1, flowers; fig. 3, fruit; fig. 4, cross-section of the flower, showing the usual placentation; fig. 5, median longitudinal section of the flower; fig 6, ovule All the drawings except fig. 2 are considerably magnified.

Apodanthes globosa Watson — Fig 7, longitudinal section of a staminate flower; fig. 8, the same of a pistillate flower; figs. 9 and 10, successive (rather thick) cross-sections, showing the varying placentation at different heights in the ovary. This may also be clearly seen in the longitudinal section, fig. 8.

[1] In De Candolle's *Prodromus*, vol. xvii, p 115.



F W ANDERSON ad nat del

ELLIS & ANDERSON on NEW SPECIES OF MONTANA FUNGI

BRIEFER ARTICLES.

Erythræa Pringleana Wittr. nov. spec.— Planta annua, subparva, 8–21 cm. alta, paullulum ramosa, glabra; foliis omnibus brevioribus quam internodiis; foliis infimis non rosulatis, ovatis apice acutato, brevissime pedunculatis, minimis, 2–3 mm. longis; foliis inferioribus lanceolatis, 3-6 mm. longis; foliis mediis et superioribus lineari-subulatis, 6–15 mm. longis; floribus longe pedunculatis, pedunculis plerumque longioribus quam floribus; sepalis eadem fere longitudine vel paullo longioribus quam tubo corollæ; hoc tertia fere parte breviore quam laciniis limbi; his 7–10 mm. (plerumque 8 mm.) longis, ovatis apice paullulum crenulato; corolla emarcida laciniis limbi contortis persistente, fructus includente; antheris staminum brevioribus quam filamentis; germine eadem fere longitudine vel paullulo longiore quam stylo stigmateque.

Mexico: in collibus prope Guadalajara 18 $\frac{5}{1}$ 88 legit cl. *C. G. Pringle*, (no. 2595).

Haud impossibile mihi videtur hanc speciem cum *Erythræa tenuifolia* Martens et Galeotti, anno 1844, ad exemplaria prope Guadalajara lecta, manco in modo descripta, identicam esse. Nomen specificum "tenuifolia" tamen secundum legem prioritatis non est retinendum, quia cl. *Grisebach* Erythræam alteram (e Hungaria et Gallia) jam anno 1839 sub hoc nomine descripsit.— VEIT WITTROCK, *Stockholmia* mense Januarii 1891.

[It may be well enough to state in this connection that what was distributed as "*Microcala* n. sp." (no. 2598) is *Schultesia Mexicana* Watson, n. sp., soon to be published.—C. G. PRINGLE.]

New species of Montana fungi (with plate X).— The illustrations of two new species of Montana fungi described last month, p. 47, were received after the number was in press. At the authors' request they are now published with the accompanying

EXPLANATION OF PLATE X.—*Sporidesmium sorisporioides* Ellis & Anders. 8, fungus about natural size on dead wood of Populus tremuloides; 9, small mass of spores superimposed on the hyaline, semiamorphous mycelium, from the swelling up and internal division of the elongate ends of which the spore-masses are developed; 10, two mature spore-masses, *A* having become quite free from the mycelium.

Aecidium Liatridis Ellis & Anders. 11, portion of leaf of Liatris punctata about natural size showing a patch of the fungus; 12, a small patch considerably magnified; 13, a perfect tube (cup) more highly magnified. At *A* is shown a cup that has gradually broken down to almost the surface of leaf; 14, four spores; 15, several cells of host

tissue showing the mycelial threads of the aecidium which permeate the leaf tissue in all parts of the affected spots; 16, a few of the pseudoperidial cells highly magnified to show their true shape.

EDITORIAL.

ONE OF THE hard questions that working botanists are called upon to answer, especially those who are also concerned in training botanists, is "what original work shall I do?" The background of the question usually contains no literature and no appliances other than a few standard botanical works and a microscope. There seems to be a widespread notion that when one comes into the possession of a compound microscope he is equipped for "original work." The lack of literature and collections precludes the recommendation of any systematic work. The general lack of knowledge as to the ease with which certain important physiological phenomena can be observed, usually excludes any such answer to the question. Besides, the applicant for "original work" expects that it will involve doing something with his microscope. Nine times out of ten the advice will be given to study the minute anatomy of some plant, as the easiest thing to do. Naturally this is the expected advice, and sectioning and drawing begin at once. But the proper study of the minute anatomy of any plant is far from being "the easiest thing to do," and to recommend any such study to one who has not been thoroughly trained by a competent instructor, is to make a great blunder.

IN THE first place, the ability to correctly interpret is not in the possession of any tyro who can cut a section or focus a microscope. There are more optical illusions due to the microscope than to anything else, and it is chiefly these illusions that will be drawn and reported when difficult, and hence interesting, structures are being investigated by an untrained observer. The unrecognized hiatuses in what appears in the field of the microscope may be small enough when measured by the metric system, but they may be of infinite importance in the interpretation of structures. Such work can only be done by the most careful and reiterated labor of a trained observer. Of course all this only applies to cases where publication is contemplated, for any amount of valuable information may be obtained in a very pleasant way by any one who is doing such work merely for his own edification. But when work rises to the dignity of being called "original investigation," it is proper that it be hedged about by a full knowledge of its real difficulties.

IN THE second place, the claim that no library is needed for such work, and that all that one needs is a microscope, is a mischievously false notion. It is far easier to-day to command a literature that will enable one to do some systematic work upon the flora of North America, than one which will enable an anatomist to properly discuss an anatomical subject. The absence of references to literature (and by this is not meant foot-note references) in such investigation leaves the work "in the air." It is like shooting with a shotgun in the general direction of the game in the hope of hitting something. If the investigator is not prepared to say what he has found that is new, no one else is apt to take the trouble to do it for him. The sooner we can get rid of the notion that a microscope is a magic instrument, which when touched transforms one into an original investigator, the better. It is just as magical as a hand-saw, of which tool one may possess a chest-full, and yet not be a carpenter.

CURRENT LITERATURE.

The grasses of dry climates.[1]

The author of this paper calls attention to some hitherto unknown peculiarities in the grasses of dry climates, among them being the singular development of the lowest internodes of the culms, shoots and basal leaves. He considers these characters just as important as the interior structure of the leaves for adaptation to a dry climate. He distinguishes: 1. tuberous and bulbous grasses; and 2. tunic-grasses. Tuberous grasses are such as *Phleum pratense* var. *nodosum* Gaud. and *Arrhenatherum avenaceum* var. *nodosum* (*Avena nodosa* L.), of which one or more of the basal internodes of the culm and shoots attain a tuberous development, while *Poa bulbosa* L. represents a bulbous grass, since here the bases of some of the sheaths of the leaves have increased in thickness and form a bulb very much like that of an Allium. The tuberous grasses are relatively rare in comparison with those whose culms are not thickened, a circumstance which has led to their being ranked as mere varieties. Such forms are especially prevalent in the Mediterranean countries. The same is also the case with Poa bulbosa, which occurs more commonly in these countries than further north. Besides the above mentioned, are the tuberous

---

[1] E. HACKEL.— Ueber einige Eigenthuemlichkeiten der Græser trockener Klimate.— Verhandlungen der k. k. zool.-botan Gesellsch. Wien, Jahrgang 1890, pp. 125–138.

Alopecurus bulbosus L. and the bulbous *Festuca spadicea* L., the only ones of this group which occur in Middle-Europe.

The author, has, however, observed similar forms to be abundant and more characteristic of other parts of the world. Those he enumerates from our own country are as follows: From California and the Western States the tuberous *Melica bulbosa* Gey., *Californica* Scribn., *spectabilis* Scribn., *fugax* Bol., *bromoides* Gray and *subulata* Scribn., *Beckmannia eruciformis* Host. and finally from Mexico the tuberous *Panicum bulbosum* Kth., *scaberrimum* Lag. and *Torreyi* Tourn.

These tuberous and bulbous forms only occur in countries with periodical dry seasons, and none have been observed in the moist parts of the tropical region. It is very interesting to learn that the author does not consider these tubers or bulbs as reservoirs of starch or sugar, as are the similar organs of Liliaceæ, Iridaceæ, etc. Though they are structurally homologous with these, physiologically they are water-reservoirs. The author has shown that Poa bulbosa on being cultivated in moist soil almost lost its bulbous character.

The second group, *Gramina tunicata*, includes forms in which the base of the culms and shoots are covered with at least three faded sheaths. These all inhabit dry localities. In those forms which prefer damp or shaded places, there is usually but one faded sheath present, and even that disappears very soon. The typical tunic-grasses are especially characteristic of the Mediterranean region, and besides the tuberous and bulbous forms, all the other perennial Mediterranean species belong undoubtedly to this group. The author distinguishes between straw- and fiber-tunics; in the former the sheaths remain complete, although faded, in the latter the sheaths break up into fibers. Of these two groups the fiber-tunics are characteristic of the Mediterranean region, while the straw-tunics occur in all the other countries with similar climate. Some forms from Australia, Capland, India, Brazil and North America show the development of wool or felt on the sheaths, as for instance *Eragrostis eriopoda*, *Danthonia lanata*, *Bouteloua eriopoda* and others, representing wool- and felt-tunics. The function of these different tunic structures is undoubtedly to serve as reservoirs of water, as has been proved experimentally in the case of Koeleria setacea and a variety of Andropogon contortus. The author of this interesting paper calls the attention of botanists for further studies upon this subject.—THEO. HOLM.

Minor Notices.

MR. A. S. HITCHCOCK, of the Shaw School of Botany, has just published a catalogue of the vascular plants in the vicinity of Ames, Iowa. It is no. 7 of the contributions from the Shaw School. The

list is based upon collections made during the years 1882 to 1889, and shows very careful work. Specialists have been consulted in their various groups, and the nomenclature follows the use of the oldest specific name in every case, accompanied by many useful citations of authorities.

THE LAST number of *Pittonia* is before us (vol. ii, part 9) and we note the following contents: In a discussion of the genus Actæa, Prof. Greene doubts whether we have the true Old World A. spicata with us at all, and is also confident that we have 3 or 4 species of our own. He characterizes a new species from Arizona. Ranunculus ellipticus is a new species to replace much that has been called R. glaberrimus. A very useful feature of this number is the reprint of the old Fraser's Catalogue, really written by Nuttall, often referred to, and very inaccessible. American botanists will thank Professor Greene for this valuable addition to their reference libraries. A prominent contribution is that concerning some genera of Rafinesque. It would be a wonderful relief if botanists could be certain once for all just what genera Rafinesque is entitled to. Some 14 or so are recognized in Gray's Manual, and Professor Greene thinks the number will eventually be almost doubled. He presents the following results of his bibliographical investigations: *Shepherdia* Nutt.= *Lepargyræa* Raf.; *Maclura* Nutt.= *Ioxylon* Raf.; *Downingia* Torr.= *Bolelia* Raf.; *Echinocystis* T. & G. and *Megarrihiza* Wats.= *Micrampelis* Raf.; *Stephanomeria* Nutt.= *Ptiloria* Raf. Of course these conclusions are accompanied by a presentation and naming of all the species. The North American species of the genus *Lotus* (= *Hosackia*) are presented, to the number of 54. The part closes with a revision of the genus *Diplacus* Nutt., a genus including a few species usually referred to *Mimulus*.

MR. THEODOR HOLM, of the U. S. National Museum, has long been studying the underground structures of plants, a very much neglected study. In a paper (reprinted from the January number of the *Bull. Torr. Bot. Club*, pp. 1–11) he contributes some very interesting information concerning Uvularia, Oakesia, Dicentra and Krigia. The descriptions are elucidated by three excellent plates.

OPEN LETTERS.

Last words on "biology."

I had thought that botanists were a gentle folk, but in the late numbers of the GAZETTE I have been treated in the same manner as they treat their plants—pulled to pieces. One accuses me of missing the whole point in question, while the other charges me with all the sins in the philological and metaphysical decalogues.

I have received no little information (or misinformation) from these two articles, but the point I made has been ignored.

The question in my mind resolves itself merely into this. Can a man teach biology without teaching the whole of the subject? Can he teach mathematics, unless he teach both arithmetic and quaternions? Can he teach modern languages unless he teach the whole 961 tongues? I claim that he can, and, words aside, this was the whole contention of my previous letter.

If a college or university is in position to give a well rounded biological education it is certainly its duty to do so, and I, as heartily as any one else, can find fault for short-comings in this respect. But if the institution be limited neither botanist nor zoologist should find fault because the biological training has a distinct trend towards either animals or plants, so long as it has a distinctly *biological* character, and it will have such a character if it regards its materials as a part of the living world. For the comfort of my critics I may add that the reason why the majority of such biological chairs are filled with animal biologists is because such have had on the whole the better training.— * * *

Pocket edition of Gray's Manual.

An announcement just made by the American Book Company, publishers of Gray's botanies, possesses unusual interest for botanists. It is of a special edition of the Manual "in small and compact form for satchel use." This is to be printed on thin French paper with narrow margins, so as to make it small and thin. It will be bound in full leather, limp, and cut flush, very much like a foreign guide book. The binding is to be on parchment strips such as are used in the best English prayer books, and the book is intended to stand rough usage. To many it will be a matter of sincere congratulation, that we are to have the indispensable "Manual" in field form. Its issue may be looked to with interest, since it is to be sold at the moderate price of two dollars.— AUG. D. SELBY, *Columbus, Ohio.*

NOTES AND NEWS.

DR. C. F. MILLSPAUGH, in *Zoe* (Jan.), describes two new Euphorbias from Lower California.

THE *Annals of Botany* proposes hereafter to give considerable prominence to systematic botany.

IT IS REPORTED that Pachystima Canbyi is in successful cultivation in the public gardens of Münden, Germany.

MR. F. W. ANDERSON is drawing the 60 plates to illustrate Mrs. E. G. Britton's Handbook of Mosses of N. E. America, which is in preparation.

MR. HEMSLEY'S place in the Kew Herbarium, left vacant by his promotion, has been filled by the appointment of Dr. Otto Stapf, of Vienna.

A CONVENIENT KEY to the genera and species of British mosses is published (with a plate) by Rev. H. G. Jameson in the last *Journal of Botany* (Feb.).

MR. F. H. KNOWLTON, of the U. S. Geol. Survey, has published an account of fossil woods and lignites from Arkansas. Two new conifers (Cupressinoxylon) and two new dicotyls (Laurinoxylon) are described and figured.

IN THE *Philadelphia Public Ledger* of Jan. 20, Mr. Thomas Meehan publishes an interesting account of an almost forgotten botanist, Mathias Kin, a man well know to Muhlenberg and Collins, and about whom Dr. Asa Gray wrote that his history should be worked up by Philadelphia botanists.

IN AN INAUGURAL dissertation at Erlangen, Georg Schneider shows that the "wax" of Myrica cerifera is more nearly allied to the fats than to the wax-like bodies. It consists chiefly of palmatin (70 per cent.) myristin (8 per cent.) and lauric acid (4.7 per cent., mostly free), to form which 9.4 per cent. of glycerin is combined with the corresponding fatty acids.

SOME ACCOUNT of the occurrence and life history of the clover rust (*Uromyces Trifolii* Wint.) has been published by Miss J. K. Howell, (Bull. Cornell Exper. Station, No. 24). The uredo stage was produced upon both red and white clover plants by artificial sowing of the æcidiospores. Attempts to germinate the teleutospores in the spring unexpectedly proved quite fruitless.

DR. JOSEPH BOEHM has at least the merit of consistency in the framing of his theory of transpiring plants. It follows, he says to the Royal Botanical Society of Vienna,[1] since capillarity is the cause of the absorption and ascent of water in transpiring plants, that under certain conditions the transpiration stream may be reversed, so that water must escape from the plant into the ground!

IN THE last *Bulletin of the Torrey Botanical Club* (Feb.) Dr. Morong gives an interesting account of the flora of the desert of Atacama. In the same number Dr. Britton describes six new plants from Dr. Rusby's S. American collection, belonging to the following genera: Begonia, Hariota, Hydrocotyle, Arracacia, Sciadophyllum, and Oreopanax; and Mrs. Britton describes and figures two new Idaho mosses, a Grimmia and a Bryum.

THE PRODUCT of marketable shoots of asparagus is found by W. J. Green (Bull. Ohio Exper. Station, iii, p. 241) to be fifty per cent greater from male plants than from female plants. Preliminary tests were made in 1889, and more complete tests in 1890. During the latter year 50 plants of each kind were used. The difference in vigor is ascribed to the exhaustive effect of seed bearing in the female plants, which is absent in the male plants.

PROF. DR. F. B. POWER and Mr. J. Cambier have recently examined chemically two of the best known "loco-weeds," Astragalus mollissimus and Crotalaria sagittalis. They close their paper in *Pharm. Rund-*

[1] Bot Centralb. xliv, 355.

schau (Jan.) by saying: "These results have afforded us the conviction that both the Astragalus and the Crotalaria contain very small amounts of toxic alkaloids, to which we believe the symptoms of poisoning produced by these plants may reasonably be attributed.

IT IS WELL established that the ovules of the higher plants are homologous with the sporangia of vascular cryptogams. The sporangia in the latter are produced on leaf-structures—the sporophylls. In the Angiosperms the question of their origin is unsettled. Gœbel investigated a considerable number of doubtful cases. His results are confirmed and extended by Schaefer[1] who finds that in all cases the placenta develops as a part of the carpel and not in the axil of the carpel.

MR. CHARLES ROBERTSON has continued his interesting series of observations on flowers and insects by publishing the *Umbelliferæ* in *Trans. St. Louis Acad. Sci.* (vol. v, no. 3). The group is so uniform in flower-structure, and the species bloom so continuously through the growing season, that they are specially favorable for investigation concerning the effect of time of blooming on the character of the visitors. In his general review of the order Mr. Robertson draws some very interesting conclusions, which are too numerous and specific to be enumerated here.

THE REPORT of the botanist of the Department of Agriculture for 1890 will show that the following collectors have been at work during the year in unexplored or interesting regions: Dr. Edward Palmer in Lower California, Western Mexico, and Arizona; Mr. G. C. Nealley in Western Texas; Mr. J. H. Simpson in the region about Manatee, Florida; and Mr. C. R. Orcutt in the Colorado Desert of Southern California. All these collections either have been or will be reported upon in the new series of "Contributions" now being issued by the National Herbarium.

IN THE *Amer. Chem. Jour.* (xiii, 1) Dr. H. W. Wiley gives an account of "pine-tree honey-dew" and "pine-tree honey." His conclusion is that the "honey-like exudation of the pine tree differs in a marked degree from the honeys of ordinary plants in being right-handed, from a polariscopic point of view, and containing bodies not sucrose nor invert sugar, with a specific rotatory power of about 105." Honey made from this pine-exudation is naturally right-handed, a character as yet observed to be possessed by no genuine honey collected in this country.

HERETOFORE no cells have been recognized in the vascular bundles of the Gymnosperms, which were either the anatomical or physiological representatives of the "companion-cells" of the sieve-tubes. Strasburger, however, now considers the parenchyma cells, rich in protoplasm, which surround the sieve-tubes or are distributed between them as the physiological equivalents of the companion cells. These cells stand in intimate physiological and anatomical relations with the sieve tissue, by means of pits.—Cf. Sitz. d. königl. Preuss. Akad. d. Wiss. zu Berlin. 1890. xiii.—Abstr. in Bot. Cent. xliv. 192.

---

[1] Flora, 1890, heft 1, *fide* Bot. Cent. xliv, 368.

F. LUDWIG finds in the Synchytrium-galls on Anemone nemorosa a red coloring matter, readily soluble in water, whose identity with anthocyanin he has established. It is a derivative of tannin. He raises the question as to its significance—whether it is a purely pathological product, or whether it serves as a protection to the fungus against snails. He points out the general red coloration and abundance of tannin in insect galls and reminds his readers of Stahl's researches which show the avoidance of tannin-bearing plants by snails. —Cf. Verh. bot. Ver. d. Prov. Brand. XXXI. p. VII, and Bot. Cent. xliv. 82.

THREE NEW methods of preparing aleurone grains of Ricinus are as follows: 1. The Overton method.[1] After hardening sections for several hours in absolute alcohol, immerse them in an aqueous solution of gallotannic acid. The crystalloids absorb the acid and become brownish on treatment with 1 per cent. osmic acid. After washing in distilled water place in glycerine. 2. Poulsen's methods.[2] (*a*) Harden in absolute alcohol 24 hours; place for an hour in a 25 per cent. aqueous solution of tannic acid; wash in distilled water; place in an aqueous solution of bichromate of potassium and allow to remain until brown. Wash and preserve in glycerine. (*b*) Treat as in (*a*) but use a 10-20 per cent. aqueous solution of sulphate of iron (which results in a deep blue coloration), wash, dehydrate, clear with clove oil and mount in balsam.

PFEFFER criticizes the conclusions of Hugo de Vries and his pupils as to the origin of vacuoles and the plasma membranes of the cell. (For these views see notes in this journal, xiv. 24, 137.) Pfeffer however affirms[3] that he has been able to produce vacuoles artificially in the plasmodium of Chondrioderma difforme by causing it to enclose solid particles of various soluble substances. The artificial vacuoles were in no wise distinguishable from the true. He also observed the division and fusion of these vacuoles, as well as their fusion with a pulsating vacuole. In some cases they even showed a slight pulsation themselves. His criticisms on the existence, origin and significance of the membrane surrounding the plasma and the membrane enclosing the vacuole are equally radical. A clear insight into these structures seems not yet reached.

THE PRESS, a daily paper of Christchurch, New Zealand, bearing date of Jan. 16, has just been received, giving account of the opening sessions of the other A. A. A. S., the Australasian Association for the Advancement of Science. The sessions began January 15, at Christchurch, in Canterbury College, with the distinguished botanist Baron von Mueller in the chair as retiring president. The proceedings are reported in full, and the whole affair seems full of an energy and spirit which augur well for the future of the younger A. A. A. S. It will be remembered that at the Indianapolis meeting of the American Association the retiring President, Dr. Geo. L. Goodale, was appointed as

---

[1] Cf. Bot. Cent. xliv, 1 (1890). [2] Rev. gen. de Botanique, ii, 547.
[3] Abhand. d Math.-Phys Class. d. Sachs. Gesells. d. Wiss. xvi, p. 185—345. —Abstr. in Bot. Cent. xliv. 180.

representative to the Australasian Association. The New Zealand paper gives an account of his cordial reception by the association, and his address in reply. An interview with Prof. Goodale is also printed, in which he gives the Australasians much information concerning science in America, the American Association, and Harvard University. Prof. Goodale is travelling chiefly in the interests of the new Botanical Museum at Cambridge, and will return home by way of Java, China, and Japan.

THE PHYSIOLOGICAL significance of calcic oxalate according to Dr. G. F. Kohl[1] lies in the fact that the oxalic acid and its congeners are by-products in the synthesis of proteids from amides and carbohydrates. If this is true oxalic acid and its salts ought to occur in all plants. While however calcic oxalate in the higher plants is very wide-spread, in the thallophytes it is strikingly rare. Kohl shows that nevertheless oxalic acid is abundantly produced by both fungi and algæ, and that it will readily combine with calcium when under proper conidtions. The production of oxalic acid by the recently described Saccharomyces Hansenii has been designated as oxalic acid fermentation which is reckoned as one of the oxidative fermentations, in contrast to the splitting fermentations. Fermentation is in all cases, he says, nothing but a nutritive process of the ferment-inducing organism, with its consequences. Colorless organisms must decompose—*ferment*—carbohydrates, alcohols, etc., obtained from without; color-bearing and therefore mostly CO_2-assimilating organisms on the contrary decompose—*ferment*—self-formed carbohydrates, etc. Logically we must say: *all plants are fermenting agents;* for if we call the formation of oxalic acid by a fungus "oxalic-acid fermentation" we must extend this designation to all plants in which the formation of oxalic acid occurs. We can arrange plants in two series according to the main product of the fermentation, the first including those which induce oxidative fermentations, the second including the agents of splitting fermentations.

Plants.	*Oxidative fermentation*	*Splitting fermentation.*
Schizomycetes	acetic acid	Alcohol, lactic acid, butyric acid.
Numerous other fungi	oxalic acid carbonic acid	Alcohol.
Algæ	oxalic acid carbonic acid	———
Bryophytes, Pteridophytes, Phanerogams.	carbonic acid oxalic acid tartaric acid malic acid	———

The lower plants thus induce chiefly splitting fermentations, the higher exclusively oxidative.

[1]Bot. Centralb xliv 337.

VOL. XVI. NO. 4.—BOTANICAL GAZETTE.—APR., 1891.

New or noteworthy Compositæ from Guatemala.

JOHN M. COULTER.

Mr. John Donnell Smith has placed in my hands for determination his recent and large collections of Compositæ from Guatemala. From the long and interesting list of species that these collections contain, the following have been selected for publication as being new or especially noteworthy. In the final and critical study of species the herbarium and library of Harvard University were used, and thanks are due to Dr. Sereno Watson for his courtesy in supplying every facility for such study. Mr. Henry E. Seaton, my assistant, made all the dissections and rendered valuable service in generic determinations.

VERNONIA TRIFLOSCULOSA HBK.—Published descriptions say that the leaves are "very entire," but specimens from San Luis, Depart. Escuintla (*J. D. S.* 2377), show that the larger leaves are apt to have some callous serrulations.

VERNONIA LEIOCARPA DC.—Abundant and very fine material from Pacaya, Depart. Amatitlan (*J. D. S.* 2405), show that the heads are at first cylindrical, becoming "ovate" only with ripening and spreading, and that they are mostly 3-(sometimes 4)flowered, rather than "5-flowered."

VERNONIA SALVINÆ Hemsl., var. **canescens,** n. var.—Leaves white beneath with a dense pannose tomentum.—Coban, Depart. Alta Verapaz, March, 1881 (*Türckheim* 583).

STEVIA COMPACTA Benth.—Specimens from Volcan de Agua (*J. D. S.* 2327) show that the under surface of the leaves is apt to be more or less woolly, and that the branches and inflorescence may have more or less floccose wool.

Eupatorium Donnell-Smithii n. sp.—Usually tall and rather stout perennial herb, hirsutely pubescent especially above and in the inflorescence (the spreading hairs of the stem somewhat glandular and viscid), often glabrate below, leafy up to and in the inflorescence: leaves opposite, broadly ovate, crenate-serrate, acute or acuminate, more or less pubescent or even hirsute especially beneath and on the prominent veins, 4 to 10 cm. long, 2.5 to 6.5 cm. broad, the lower long-petioled,

the uppermost short-petioled: heads 4 to 7 mm. high, numerous in a usually broad and ample leafy panicle, with white flowers: involucral bracts narrowly oblong, acute or acuminate, in about two nearly equal rows, thickened and conspicuously striate-nerved below, thinner and sometimes almost scarious at tip (especially the inner ones, which are also more decidedly acuminate or even mucronate-tipped), the outer ones more or less hirsute (often densely so), the inner ones glabrous or chiefly pubescent at tip: heads 40 to 50-flowered, with a flat or slightly convex receptacle and corolla-lobes bearded externally: achenes pubescent on the ribs, with scanty and barbellate pappus.—Aceituna, Depart. Guatemala, alt. 4600 ft., Feb. 1889 (*J. D. S.* 2374); Coban, Depart. Alta Verapaz, alt. 4300 ft., April, 1889 (*J. D. S.* 1603); Sarnac, Depart. Alta Verapaz, alt. 4600 ft., April, 1889 (*J. D. S.* 1602); Volcan de Agua, Depart. Zacatepequez, alt. 9500 ft., April, 1890 (*J. D. S.* 2329); Guatemala, Depart. Guatemala, alt. 5000 ft., Feb., 1890 (*J. D. S.* 2365).—This species seems closely related to *E. ciliatum* Less., to which it was referred by Hemsley (*Bourgeau* 1927) and John Donnell Smith (*Türckheim* 407, in 1887); but *E. ciliatum* has 18 to 22 flowers in a head and a glabrous corolla, while *E. Donnell-Smithii* has 40 to 50 flowers in a head and a bearded corolla.

Var. **parvifolium** n. var.—Much smoother, with smaller leaves, and but 20 to 35 flowers in a head.—Dueñas, Depart. Zacatepequez, alt. 5000 ft., April, 1890 (*J. D. S.* 2333).

EUPATORIUM AZUREUM DC.?—Apparently a form of this species was collected on Volcan de Agua, Depart. Zacatepequez, alt. 9000 ft., April, 1890 (*J. D. S.* 2326), in which the heads are but 12 to 16-flowered.

Eupatorium lyratum n. sp.—A stout apparently low branching perennial herb, softly pubescent throughout (the stem often even hirsute and more or less glandular): leaves alternate, the lower ones obovate, lyrately-pinnatifid and petioled, 5 to 9 cm. long, 2.5 to 4 cm. wide, gradually becoming less lyrate, irregularly toothed, sessile and even auriculate-clasping above, the uppermost ones (in the inflorescence) merely ovate (acute) and slightly toothed or entire: heads about 6 mm. high, rather few in a very loose irregular leafy panicle, with white flowers: involucral bracts linear-lanceolate to linear, acuminate, very lax in 3 or more unequal rows (some of them exceeding the head), the inner ones linear

and somewhat scarious, all more or less pubescent (the inner ones chiefly so at the tips), the outer ones often very much so (even hirsute) and more or less glandular: heads many-flowered, with a flat receptacle, and very long and slender corolla-tubes with very minute lobes (if any) : achenes pubescent, with scanty but long and conspicuous, very minutely barbed soft white pappus.—Laguna Amatitlan, Depart. Amatitlan, alt. 3900 ft., March, 1890 (*J. D. S.* 2393). A species remarkable in its leaf characters and very long and slender corolla tube.

Eupatorium Rafaelense n. sp.—A small shrub, glabrous or minutely pubescent: leaves opposite, rather long petioled, ovate to lance-ovate, acute or acuminate, from crenate-serrate to minutely so or even entire, 3 to 7.5 cm. long, 2.5 to 3.5 cm. wide (but the numerous specimens show only the leaves of the branchlets): heads 9 to 18 mm. high, in loose or rather compact cymose clusters. terminating opposite divergent branchlets, the clusters becoming more compacted into a thyrsoid inflorescence above: involucral bracts linear-oblong, often purplish, acute or obtuse, in about 3 unequal lax rows, about half as long as the head, striate-nerved below, more or less pubescent and glandular (especially the outer ones), all with ciliate margins: heads 35 to 45-flowered, with a flattish or slightly convex receptacle and glabrous corolla: achenes scabrous-puberulent on the ribs, with conspicuous and barbellate white pappus.—San Rafael, Depart. Zacatepequez, alt. 6500 feet, April, 1890 (*J. D. S.* 2331); Guatemala, Depart. Guatemala, alt. 5000 feet, Feb., 1890 (*J. D. S.* 2368).

EUPATORIUM POPULIFOLIUM HBK.—This species seems to be very variable in the size of its leaves and flower clusters. Specimens from Laguna Amatitlan (*J. D. S.* 2400) are reed-like in habit, becoming 18 feet high, with leaves a foot or more long, compact thyrsoid panicles over a foot long and broad, and uniformly 11-flowered heads. Specimens from Cuyuta, Depart. Escuintla (*J. D. S.* 2399), are 12 feet high, with leaves not half as large, flower clusters only 5 or 6 inches long and 3 or 4 broad, and uniformly 9-flowered heads.

EUPATORIUM TUERCKHEIMII Klatt.—Specimens from Pansamalá (*Türckheim* 1342) show broader leaves than the type. They are ovate and long-acuminate, often nearly 2 inches broad.

EUPATORIUM AGERATIFOLIUM DC., var. **purpureum** nov. var.—Inflorescence with a dense purple glandular pubescence and the involucral bracts purple.—Coban, Depart. Alta Verapaz, alt. 4600 feet, May, 1887 (*Türckheim* 52).

Brickellia Pacayensis n. sp.—Closely related to *B. Hartwegi* (*Eupatorium rigidum* Benth. Pl. Hartw. 88) but the whole upper part of the plant is blackened with stipitate glands, the heads are 20 to 30-flowered, and the involucral scales are often much narrowed (linear-lanceolate to linear), longer, and more decidedly acuminate: the pappus is minutely but densely serrulate and the achenes densely soft pubescent. —Pacaya, Depart. Amatitlan, alt. 6000 feet, March, 1890 (*J. D. S.* 2389).

APLOPAPPUS STOLONIFERUS DC., var. **glabratus** nov. var. —Leaves glabrate, not all "very hirsute" as in the type.—A curious and handsome *Aplopappus* found on the crater of Volcan de Agua, Depart. Zacatepequez, alt. 12100 feet, April, 1890 (*J. D. S.* 2328).

Aphanostephus Pinulensis n. sp.—A stout very leafy and branching perennial 3 to 4.5 dm. high, rather glaucous and softly pubescent, the young leaves and branches and inflorescence more or less floccose: leaves punctate, lance-ovate to obovate in outline, the lower (blade) 9 cm. long, and on long petioles, gradually becoming smaller upwards, bipinnatifid, the oblong obtuse pinnæ more or less confluent and irregularly pinnately cleft and toothed (the whole plant with its conspicuous heads having an Achillea look): heads on short peduncles collected in a terminal corymbose cluster: bracts of the involucre lanceolate and strongly carinate: rays 5 to 8 mm. long, white, mostly reflexed with age: base of the corolla-tube in age prominently thickened and indurated, more or less persistent on the strongly angulate-costate whitish achene: pappus a very short crown with toothed edge. —Pinula, Depart. Guatemala, alt. 4400 feet, Feb., 1890 (*J. D. S.* 2407). A remarkable looking Aphanostephus on account of its broad bipinnatifid leaves.

Clibadium Donnell-Smithii n. sp.—Stem and inflorescence hirsute: leaves broadly ovate, mostly long-acuminate, with spinulose-crenulate serrulations, velvety pubescent beneath (even hirsute on the veins), scabrous above, 12 to 25 cm. long, 6 to 16 cm. broad, on long petioles: heads 4 to 5 mm. high,

in a rather small open cymose panicle: involucral bracts ovate, acute or cuspidate, ciliate on the margins, sparingly so on the back: corolla-lobes of sterile flowers with scanty pubescence if any: achenes obovate, conspicuously pilose at apex.— Guatemala, Depart. Guatemala, alt. 5000 feet, Feb., 1890 (*J. D. S.* 2347). This species is near *C. Surinamense* L., var. *asperum* Baker, but it differs in its comparatively smooth corolla-lobes of the sterile flowers, and strikingly in its large broad leaves, velvety pubescent beneath, and long petioles. From *C. arboreum* Donnell Smith it differs in its involucral bracts, leaves, and villous achenes.

MONTANOA OVALIFOLIA DC. is worthy of mention as being a plant reported before only from Bogota. These specimens are from Pacaya, Depart. Amatitlan, alt. 6000 feet, March, 1890 (*J. D. S.* 2352).

Tetragonotheca Guatemalensis n. sp. — Apparently closely allied to *T. Texana* Gray and Engelm.; but the leaves are deltoid, with mucronate serrulations and usually one or two prominent basal teeth, abruptly decurrent into a winged petiole which does not enlarge or clasp at base; leaves of the inflorescence ovate-lanceolate to lanceolate, acuminate, tapering gradually to a petiole: corolla-tubes, both of the ray and disk-flowers, very long and slender, more or less glandular pubescent, as is the whole inflorescence: pappus none in our specimens.—Senahú, Depart. Alta Verapaz, alt. 3500 feet, April, 1889 (*J. D. S.* 1592). A remarkable *Tetragonotheca* on account of its long and slender corolla tubes, the showy yellow ligules looking conspicuously slender-clawed.

Zexmenia Dulcis n. sp.—Pubescent and branching: leaves thickish, opposite, short-petioled, ovate or oblong, acute, distantly mucronate-serrate, scabrous on both sides but very much more so above, 6 to 9 cm. long, 3.5 to 5 cm. broad: heads on rather long peduncles (2.5 to 5 cm.), about 10 mm. high: involucral bracts lanceolate to ovate, mostly acute, scabrous with rough hairs: bracts of the receptacle winged on the back, with a sharply acute or acuminate minutely toothed apex: achenes of the ray 3-angled and 3-awned; those of the disk broadly winged, with usually two prominent unequal awns and numerous small squamellæ.— Rio Dulce, Depart. Livingston, alt. 0 feet, March, 1889 (*J. D. S.* 1607). Resembling *Z. scandens* Hemsl. somewhat, but differs from that species in its acute leaves, long-peduncled and smaller heads,

acute involucral bracts, merely 3-angled ray achenes, and broadly-winged disk achenes. Much more nearly related to *Z. trachylepis* Hemsl., but differs in its longer-pedunculate heads, acute involucral bracts, very acute or acuminate ("rounded at apex" in *Z. trachylepis*) chaff and unequal awns.

TITHONIA TUBÆFORMIS Lass.—Specimens collected at Pacaya, Depart. Amatitlan (*J. D. S.* 2390), show a peculiar habit. All the specimens in the Gray Herbarium are tall branching plants, while many of these are low and widely divaricate-branched at the very base.

MELANTHERA HASTATA Rich.—It is evident that this species must include *M. oxylepsis* DC., as in specimens from Pinula and Rio Amatitlan (*J. D. S.* 2342 and 2341) there are all gradations in the leaves from ovate-deltoïd (*M. oxylepsis*) to hastately 3-lobed (*M. hastata*).

ENCELIA MEXICANA Mart.—This variable species was collected at Laguna Amatitlan (*J. D. S.* 2408), and in comparing it with specimens in the Gray Herbarium it seems evident enough that it should be considered to include *E. subaristata* Gray, *E. heterophylla* Hemsl., *E. fœtida* Hemsl., and *E. cordata* Hemsl., as indicated by Dr. Gray in an herbarium note.

SPILANTHES REPENS Michx. has been heretofore reported only from the southern United States. It now comes from Coban, Depart. Alta Verapaz, alt. 4300 feet (*J. D. S.* 1614).

SPILANTHES BECCABUNGA D C.—Specimens from Dueñas, Depart. Zacatepequez, alt. 5000 feet (*J. D. S.* 2125) show that the achenes are often pubescent.

BIDENS HETEROSPERMA Gray.—Specimens from Guatemala, Depart. Guatemala, alt. 5000 feet (*J. D. S.* 2351), show that the achenes are not always glabrous.

Bidens Antiguensis n. sp.—§ PSILOCARPÆA. Closely resembling *B. leucantha* Willd. but the rays (mostly present) narrowly oblong, acute, bright yellow (8 to 12 mm. long), and the 2 (rarely 3) rigid awns perfectly smooth and widely divaricate: exceedingly variable in pubescence, from glabrous to pilose-pubescent.—Antigua, Depart. Zacatepequez, alt. 5000 feet, April, 1890 (*J. D. S.* 2354); San Luis, Depart. Escuintla, March, 1890 (*J. D. S.* 2375).

Senecio Donnell-Smithii n. sp.—A very stout woolly-pubescent perennial: leaves alternate, thick, very broadly ovate to rotund in outline, cordate at base, undulately lobed and margined with blackish mucronulations, glabrous above,

densely whitish woolly beneath, 9 to 15 cm. long, 8 to 11 cm. broad, on stout petioles: heads 8 to 10 mm. high, in a large terminal very compact panicle: involucral bracts lanceolate, hirsute and purple-tipped: ray-flowers 6 to 8, with narrowly oblong yellow ligules 4 to 6 mm. long; disk-flowers 12 to 16. —Volcan de Agua, Depart. Zacatepequez, alt. 11000 feet, April, 1890 (*J. D. S.* 2362). Near *S. Aschenbornianus* Schauer, but differs in being stouter, with much more compact inflorescence, leaves very smooth above and densely woolly beneath, hirsute purple-tipped involucral scales, and more numerous disk-flowers. A very striking and handsome species.

SENECIO GHIESBREGHTII Hort. Hal. Regel (*S. grandifolius* of authors; not Less.)—Specimens from Serraquitché, Depart. Alta Verapaz, alt. 2500 feet, (*J. D. S.* 1598), show that the characters of the species must be made to include not only ovate, but also elongated ovate or even obovate leaves, which are often acute at base as well as apex, and whose margins vary from sinuate-dentate to entire. These Guatemalan specimens also show that the disk-flowers may be fewer than 10, most of the heads containing but 5 or 6.

SENECIO GHIESBREGHTII Hort. Hal. Regel, var. **pauciflorus** n. var.—Differs from the species in having fewer-flowered heads and hairy involucral bracts.—Sapote, Depart. Guatemala, alt. 4300 feet, March, 1890 (*J. D. S.* 2359); Chucaneb, Depart. Alta Verapaz, alt. 6000 feet, April, 1889 (*J. D. S.* 1606). *S. Ghiesbreghtii* has 4 to 6 ray-flowers and 10 disk-flowers; while the variety has uniformly 2 ray-flowers and 3 disk-flowers.

Senecio Cobanensis n. sp.—A woody-stemmed glabrous and very leafy plant: leaves scattered, thickish, elongated, narrowly lanceolate to oblanceolate and acuminate, on slender petioles, usually with distant serrulations, 10 to 14 cm. long, 2 to 2.5 cm. broad, readily falling off and leaving the stem covered with prominent scars: heads discoid, about 6 mm. high, in terminal rather loose corymbose panicles: involucral bracts about as long as the head, linear-oblong, obtuse or acutish, thick and rigid, keeled and somewhat saccate below (forming a truncate base to the head), often with very small accessory bractlets: disk-corollas about 6, deeply 5-lobed, the lobes usually with inflexed tips: achenes glabrous.—Coban, Depart. Alta Verapaz, alt. 4300 feet, May, 1887

(*Türckheim* 1158). A species perhaps nearest to *S. Candelariæ* Benth., but very distinct.

PEREZIA NUDICAULIS Gray.—Specimens from Guatemala, Depart. Guatemala (*J. D. S.* 2364) show that the leaves are not "all runcinate," some of them being simply ovate.

SENECIO KERMESINUS Hemsl. (*Gynoxys Hænkei* DC.)—Abundant material from Guatemala, Depart. Guatemala. alt. 5000 feet (*J. D. S.* 2356), shows that the original description of De Candolle needs emendation, as that was professedly drawn from imperfect specimens showing only the upper leaves. The lower leaves are coriaceous, rugose veiny, and more or less coarsely toothed. The heads also frequently have more numerous flowers. The plant is a very handsome one, climbing high over trees.

Wabash College, Crawfordsville, Ind.

Notes on North American Willows. VI.

M. S. BEBB.

A review of the willows of California.

More than ten years have elapsed since the publication of the second volume of the Flora of California. I wish to look over the account given therein of the willows, make some comments in the light of a better information, and correct mistakes.

1.[1] SALIX NIGRA Marsh.—This species, in its distribution from Texas southward and westward, presents two diverging lines of variation. Southward, along the Gulf coast, it passes by insensible gradations into the Mexican form of *S. Humboldtiana*. Westward, across the plains of New Mexico and Arizona, it takes on the character of var. *venulosa* Anders. with the lower leaves of the branches oblong, rather obtuse, often mucronate, later leaves at the tips of the branches attenuate-linear, all yellowish-green (at least in herbarium specimens) and veiny; mature capsules yellowish and long pediceled. Var. *Wrightii* And. is the same thing only representing (as it appears to me) an abnormal or retarded

---

[1] The numbers correspond with those of the Flora of California.

growth of the individual tree from which Wright's specimens were taken. Nevertheless, as Andersson insists upon the "short, thick, densely flowered aments," as essentially distinguishing this variety, it may be as well to avoid forcing a decision upon the scanty material at present available. *S. nigra* var. *venulosa* extends to the Sierra Nevada Mountains, but whether Bolander's specimens (leaves only), from Cache Creek near Clear Lake, show a reversion on the Pacific slope to something like the typical form of the species, or whether these were taken, late in the season, from the extreme tips of branches of var. *venulosa*, or whether it is not even more probable still that these long, narrow, sharply serrate leaves indicate an outlying northern station for *S. Humboldtiana* var. *oxyphylla* is a question that can receive no satisfactory answer until much more is known than we now know of the forms which *S. nigra* assumes in southern California and northern Mexico.

2. S. LÆVIGATA Bebb.—This fine willow reaches its fullest development in central and southern California. It is not know as an Oregon species, though collected by Mr. Joseph Howell, just south of the boundary line in Siskyyou county. Southward it takes on a serotinous mode of inflorescence, like other northern species which invade the tropics.

3. S. LASIANDRA Benth.—Local observers may be inclined to regard the more pronounced varieties as distinct, but if so I am unable to limit them. In a broad and comprehensive view the propriety of uniting the Rocky mountain and Pacific coast forms under one species and keeping this distinct from *S. lucida* of the Atlantic coast will, I believe, be conceded. *S. lucida* var. *macrophylla* Anders. referred "from the description" to *S. lasiandra* var. *lancifolia* I have since seen, not only in Dr. Lyall's (type) specimens, but in others from the Columbia River, in which the peculiarity described is exhibited in a still more marked degree. It is simply a broad-leaved, showy-flowered state of var. *lancifolia* with nothing whatever to indicate any particular affinity with *S. lucida*.

4, 5, 6. THE LONGIFOLIÆ.—This group is distinctively American, clearly defined on every side, shading off into no other by variation, hybridizing with none. It is not connected with Old World forms by any synthetic type of the present or of any preceding period, but apparently was derived from the Mexican plateau at the close of the Tertiary.

In keeping with this view it finds its fullest development and greatest variation in form and stature on the Pacific slope. Eastward it declines in vigor and variability until on the Atlantic coast it is of rare occurrence from New Brunswick to the Potomac. Clearly marked as are the outer limits of the group it presents no lines of cleavage within by which it can be satisfactorily divided. No natural characters are found to coincide with such assumed distinctions, for instance, as the "linear lobes of the stigma," made prominent in the attempt to separate *S. sessilifolia.* Each portion after sub-division remains as heterogeneous as was before the aggregate group. It may be possible, by emphasizing first one character and then another, as these are found to predominate in the different forms, to designate a number of sub-species and varieties; but so bewildering and intangible is the reticulated intergrading that the difficulty of segregation seems only to be heightened by every fresh acquisition of material.

7. S. CORDATA Muhl.—No American willow has a wider distribution than this, from the Gulf States to California and northward in the interior to the Mackenzie River, and perhaps none other—not even excepting aggregate *S. longifolia*—presents more the appearance of a "congeries of species in the making." It differs from *S. longifolia* however in being, of all our willows, the one which hybridizes most freely with others and this implies that even where actual hybridity can not be proven it is more or less affected by association with other willows in different portions of its wide area of distribution.

8. S. LASIOLEPIS Benth.—Ten years ago this species was known to the writer only from Californian specimens. Even at that time three dominant lines of development were recognized, but these have since been found to lead out to such widely divergent extremes as would certainly be admitted as distinct species were it not for the intergrading. The most remarkable of these, exhibiting the var. *Bigelovii* in its farthest departure from the typical *lasiolepis* of southern California, is sent to me by Mr. C. V. Piper, from near Seattle, Washington: leaves obovate, oblong or oblanceolate, coarsely and irregularly repand-serrate, 2 inches wide by 4–7 inches long; aments as thick and copiously silky with long hairs as those of *S. Hookeriana!* As if *S. lasiolepis* were not already overloaded with aberrant forms we have to mention still another, provisionally referred only, found by Prof. Greene on

Santa Cruz Island. Unfortunately only the leaves were obtained. These are clothed beneath with a dense velvety, *persistent tomentum.* The character "filaments more or less united at base" should be more distinctly emphasized: it is really quite constant and will often serve to identify staminate specimens unaccompanied by leaves.

9. S. FLAVESCENS Nutt.—The name was adopted at first from Nuttall's description but I have since seen specimens named by Nuttall himself which confirm beyond all question the identity of the species. The time-honored name of the Flora Boreali-Americana, *S. Scouleriana*, will probably always be retained for the Pacific Coast forms which differ most widely from the type, but as this difference is observed almost wholly in the form of the leaves and as the leaves of the type specimens of *Scouleriana*, in the Hookerian herbarium are really those of *S. Sitchensis*, we are obliged to acknowledge a certain inconsistency, for which we find excuse in a desire to perpetuate among the willows of the N. W. Coast the name of the early explorer. This is another polymorphous species, which would be more faithfullv reported if broken up into a series of varieties.

10. S. MACROCARPA Nutt., var. ARGENTEA—This beautiful little willow, with its silvery-silky capsules and foliage, and twigs overspread by a delicate glaucous bloom, may be regarded as a marked variety of the typical *S. macrocarpa* Nutt. of the Columbia River valley. An intermediate form has been conlected by Mr. Patterson in the mountains of Colorado. As has already been shown (BOT. GAZETTE vol. x. p. 221) Anderson transferred Nuttall's name to a single specimen, from Hudson's Bay, in the Kew Herbarium, and then redescribed (essentially) the Oregon plant under the name of *S. Geyeriana.*

11. S. SITCHENSIS Sanson.—Following either the analytical key or the subordinate grouping of the species, the solitary stamen now known to be constantly characteristic of *S. Sitchensis* would carry this in all its forms, over to no. 19, *S. Coulteri*—and rightly so: for while *S. Coulteri* represents nothing more than an abnormal development of *Sitchensis*, the species itself, in virtue of the single stamen, the long, slender, flexuose aments and peculiar vesture and veining of the leaves, must become the type of a new group (SITCHENSES) and be removed from its present setting. It was a mistake to arrange the little willow "collected on a high mountain

near Donner Pass" by Dr. Torrey, as a variety of *S. Sitchensis.* Similar forms occur from British America southward to Utah and California—mostly in the Rocky Mountains, all seeming to belong to one species for which *S. pellita* Anders. is the oldest name; unless this is found to be anticipated by the still older and very obscure *S. Drummondiana* Barratt. Furthermore the very interesting question whether this is a mountain equivalent of the coast *Sitchensis* remains to be demonstrated when we know the staminate aments. Why these have eluded so many collectors is a mystery! Drummond's specimens are without staminate flowers to begin with and although in recent years some of our best collectors in the West have, at my request, endeavored to secure specimens which would complete our knowledge of the species, their efforts have been, thus far, of no avail.

12. S. LEMMONI Bebb.—This appeared abundantly, and in great diversity of form in Mr. Lemmon's collections, but has not been further made known as a Californian plant. It has been found since, however, by Mr. Cusick in the mountains of eastern Oregon at an altitude of 4,000 feet.

13. S. AUSTINÆ Bebb.—This must be held in abeyance. The leaves described belong to *S. Lemmoni*, and in some (though not all) of the specimens staminate aments of *S. lasiolepis* were intermixed. There yet remain the fertile aments not identifiable with any willow of the Pacific Coast region as at present understood. Leaves to match these will, I apprehend, be found to be of the *phylicifolia* type and the emended species, I hope, may continue to bear the name; but how longs shall we have to wait for the painstaking local observer who will collect flowers and fruit, and finally foliage from the same plant?

14. S. BREWERI Bebb.—Beyond all comparison this is the rarest and most obscure of North American willows. Only in a remote degree related to any species of the region in which it was found, in fact representing a group otherwise unknown throughout the length and breadth of the Western Continent, found but once and after the lapse of more than ten years still known only from that one meager collection—surely we have presented here every indication of a species verging close on extinction.

16. S. CALIFORNICA Bebb.—In the first paper of this series mention was made of a group of willows, intermediate as it

were between *S. glauca* and *S. cordata*, distributed over the alpine regions of the Sierra Nevada and Cascade Range, and of which *S. Californica* constituted the southernmost member. Within a year or two past the collections of Piper and Smith, on Mt. Rainier and of the Macouns—father and son—in British Columbia, have shown that *S. Barclayi* Anders. known heretofore as a species of the Alaskan coast, is the northernmost representative of the series. A further consideration of this group will be made the subject of a separate paper.

17. BROWNII Bebb, var. PETRÆA (Anders.). More variable in the Sierra Nevada than in the Rocky Mountains, and including *S. tenera* Anders. Andersson first named one of Dr. Lyall's Cascade mountain willows *S. phlebophylla*, and under this name the specimens were sent out from Kew. Afterwards he restricted the name *phlebophylla* to a species of high arctic distribution and re-named Lyall's plant *S. tenera.* Watson (Bot. King's Exped., p. 326,) finding one of his willows from the Uintas, 10,000—11,000 feet altitude, agreeing perfectly with the Lyall specimen in the Gray herbarium adopted the name which he found on the label, not suspecting—as, indeed, why should he?—that the Lyall plant had been made, later, the type of *S. tenera* and that the arctic species was exclusively arctic.

18. S. MONICA Bebb.—Were I to receive to-day the poor, stunted specimens upon which this doubtful species was founded they would go into an already well filled cover marked "undetermined" and there repose until something more definite could be known about them. But *S. Monica* is no longer subject to the whim of its author. What is it? Possibly a form of *S. chlorophylla* And. This is known to occur on Mt. Adams and the higher summits of the Cascades and has also been collected by Prof. L. F. Ward in the Wahsatch mountains at 8,000-11,000 feet altitude. It is rather remarkable than otherwise that it has not been found on the peaks of the Sierra Nevada in forms about which there could be no uncertainty; but until this is done, the expediency of adding the species to the state flora on the evidence afforded by the poor, battered specimens named *Monica*, is very questionable. For the very narrow scale and the bracts at the base of the staminate ament seem opposed to any such determination; nor can *Monica* be a starved, alpestrine form of *Californica*, for this is known from almost the same locality and its

identity unmistakable. On the whole it seems best that a species of such questionable validity should be dropped.

To the list of California willows, as known ten years ago, not a single addition has been made, though it is highly probable that *S. rostrata*, *S. vestita* and *S. reticulata* will be found in the Sierra Nevada; and *S. Hookeriana* (known to occur abundantly along the coast of Oregon down almost to the boundary line) may be confidently looked for at the mouth of the Klamath river.

Rockford, Ills.

Notes on the flora of the St. Croix region.

E. G. HILL.

The Dalles of the St. Croix and the neighboring rapids are a piece of scenery very attractive to one seeking the beautiful and picturesque in nature. They are formed by a belt of trappean rocks of the copper-bearing series which crosses the river in this region, making several ridges from 200 to 300 feet high. Softer sandstones of the Potsdam or Cambrian formation, mingled with .conglomerates and shales at the points of contact, are laid down upon the trap in horizontal strata, or abut against the sides of its uplifted beds, clearly showing their unconformability. Through these rocks the river has worn a deep gorge, and by a series of rapids and low falls rushes along between bluffs descending rather steeply as wooded slopes. On the Minnesota side of the stream the bluffs recede from its banks far enough to leave a nearly level spot on which stands the lower part of the village of Taylor's Falls. On the opposite slope, in the state of Wisconsin, lies the village of St. Croix Falls. In the midst of the rapids the river is spanned by a bridge at a point where it becomes quite narrow at the head of a defile, making it easy to cross to either side. For some distance below the bridge the water rushes on over the sloping rocks in impetuous swirls, then makes a sudden bend and glides on with comparative placidity between cliffs from 100 to 200 feet high. The walls of these cliffs are either vertical or nearly so. The Dalles are properly that portion of the gorge beginning at the bridge, and furnish much the most imposing part of the scenery. It con-

tinues for several miles, but the rocks, composed of softer or less elevated materials have been worn away to a greater width, and the bluffs and cliffs again recede from the river, leaving a strip of flats along its banks. About two miles below Taylor's Falls another cañon is formed, called the Lower Dalles, but it lacks the wild rapids connected with the Upper Dalles.

To clamber over the rough rocks, to climb the steep ridges and the cliffs where practicable, to gather plants whose home is in such haunts, while enjoying the enchanting views, is delightful though wearisome work. One is also reminded that he is on ground somewhat classical for the botany of the upper Mississippi, since he is collecting in the footsteps of men who have honored names as pioneers in botanical exploration. Here Dr. Douglas Houghton collected plants in 1832, acting as surgeon and botanist to the expedition of Schoolcraft to the source of the Mississippi river. On its way home it explored the St. Croix, passing up this stream and crossing the narrow divide that separates it from the Brulé or Burntwood river, down which the party passed to Lake Superior. Some of the plants secured in this and the preceding expedition of 1831 are listed in the appendix to the narrative of the expedition to Itaska lake, and are credited to the St. Croix river. The late Dr. C. C. Parry, one of the members of Owen's Geological Survey, whose work included this region, collected here in 1848, and several of the plants given in the catalogue as a part of the report are from the St. Croix river, the Falls of the St. Croix taking their full share.

The time of visiting the Dalles was opportune in another respect, as it coincided with the occurrence of a log-jam for which this part of the St. Croix is noted. This had a botanical side, and furnished matters for reflection to one at all interested in the problem of forestry. To see the millions of feet of logs piled several deep in the river, and bridging it over a mile of its length, gave one a vivid idea of the rate of destruction at which the forests of pine along the upper St. Croix and its tributaries must be going on, in order to supply this material. And when this mass was added to the logs of numerous streams carrying their burdens to the Mississippi and the Great Lakes, and to the quantities of lumber transported by cars and water-craft, one could but ask in despair how long this can continue before the last stick is taken.

The forcing of the logs from their chaotic tangle by the skillful raftsmen looked like a perilous undertaking, but all passed off without serious accident. Many excursionists came from surrounding parts to see the jam, and watched the workmen with deep interest. The excitement of a spectator was at its height when a large section of the raft began to move, and the lumbermen hurried ashore to escape from the rush of logs coming down with resistless weight. There were heavy sounds of rubbing, and grinding and crushing, and if one of the smaller logs became fast in the rocks, or was caught and turned on end, it was quickly snapped in two. Again the huge raft crowded down from above and filled the space in the gorge vacated by the outgoing timbers, only to stop once more as it reached the sharp bend at the foot of the rapids, and the logs were wedged in between the cliffs. This operation was repeated several times, till the defile was cleared and the logs above ceased to come down in quantities sufficient to fill it. These were then loosened by degrees, and sent down in a safe number till the stream was cleared of obstructions after a work of a fortnight. As a witness of the jam and of the thousands of logs which, so to speak, passed in review, a deep impression was made upon my mind other than those due to its novel and exciting features. It represented a great waste of material from the point of view of true forestry and of the real lumber interests of the country. Multitudes of the logs cut for the mills were little more than poles, and far too many besides cut from trees too small and immature for the profit which a wise regard for the future would dictate. True it is claimed by lumbermen that it is best to cut all the merchantable trees from a tract they may be cutting over, because all that are left become a prey to fires rendered much more frequent and destructive by the dry remnants of trees. This may be a valid excuse under existing regulations; but it proves still more clearly the need of adequate forest management either by state or national government to check the waste from any cause.

There are features of more than usual botanical and geological interest to one working among the rocks of the St. Croix. The mass of the rocks is greenish, or grayish-green, and granular, porphyritic, or amygdaloidal in structure. Being unaware of the nature of the outcrop at the time of visiting the Dalles, their identity with those on the Keweenaw

Peninsula was at once recognized. Hand specimens of the two could hardly be distinguished from one another. They are such as bear the general designation of melaphyr, the diabase-porphyry of Irving.[1] It is evident to those studying the relations of plants and soil, that the materials arising from the decomposition of such rocks will to some extent affect the flora. The shaded cliffs, and crevices by which they are seamed and broken in many ways also afford a congenial home for numerous ferns. They were not only in great abundance, but also of fine development. They may be called the most characteristic features of the flora of the Dalles.

The most interesting fern I met with was *Aspidium fragrans* Swartz. Some fronds were nearly a foot long, exclusive of the chaffy stipe. Its pale or ashy color, its glandular pinnae, its balsamic fragrance, at once show that a fern quite different from the common kinds is in hand. It grows in the clefts of the rocks, preferring the shaded, vertical fissures, clinging to them where a foothold can be obtained. Dr. Parry first detected it here within the limits of the United States. He remarks of it in his Catalogue: "I am informed by Dr. Torrey that this species has never before been found in the United States, but has been obtained in British America and Kamtschatka. In the locality here specified it is quite abundant."[2] It is still abundant, at least on the Wisconsin side of the river, where most of the ferns collected were obtained. Since Parry's discovery of it here it has been found in several localities from northern New England westward, keeping well towards the British Provinces.

Woodsia obtusa Torr., is seen in similar situations, but is not so abundant. *Woodsia Ilvensis* R. Br., is one of the most frequent of the rock ferns, growing on their exposed faces in all localities. Wherever I have found it, and this has been in many localities from the Saguenay westward in the region of the St. Lawrence and the Great Lakes, it shows itself a plant capable of enduring the severest drouths. The fronds often look crisp and apparently dead, but quickly revive when moistened.

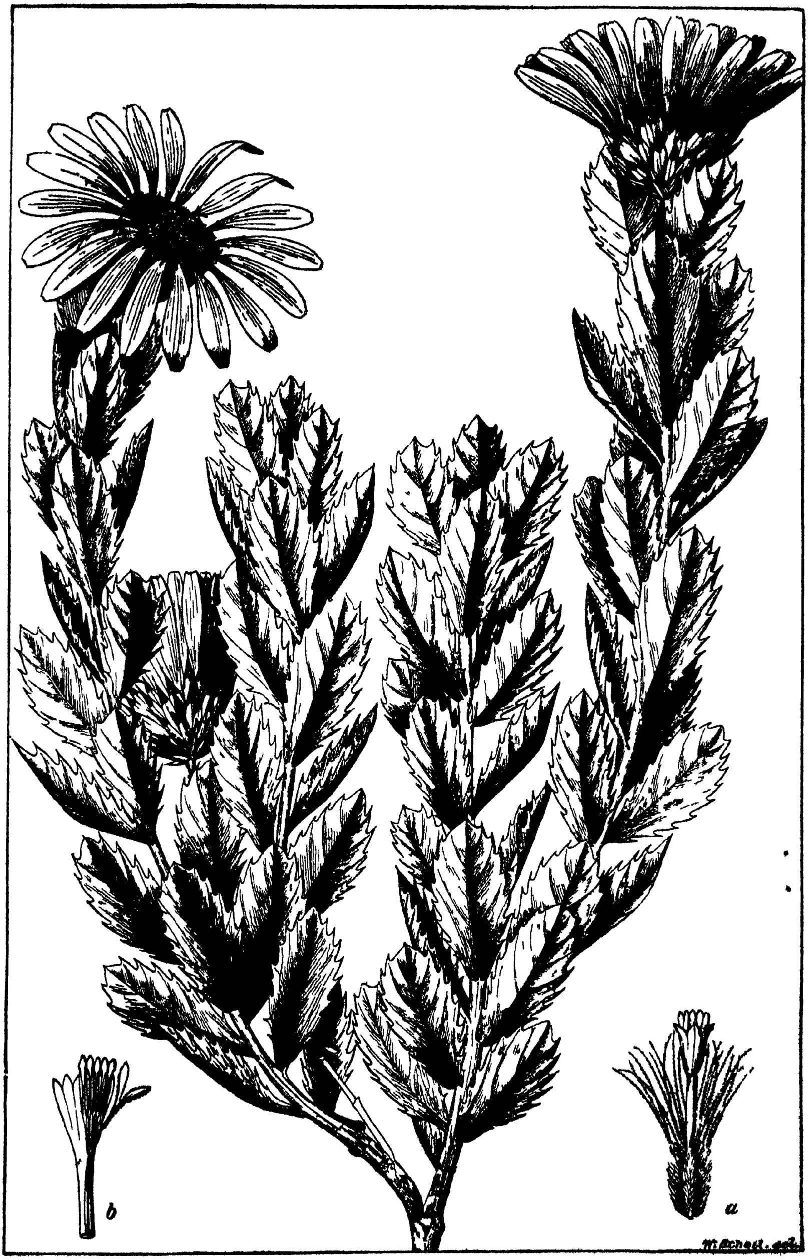
The delicate *Cystopteris fragilis* Bernh. was obtained from the shaded cliffs, and on the Minnesota side a few specimens more like the var. *dentata* Hooker were taken from similar

---

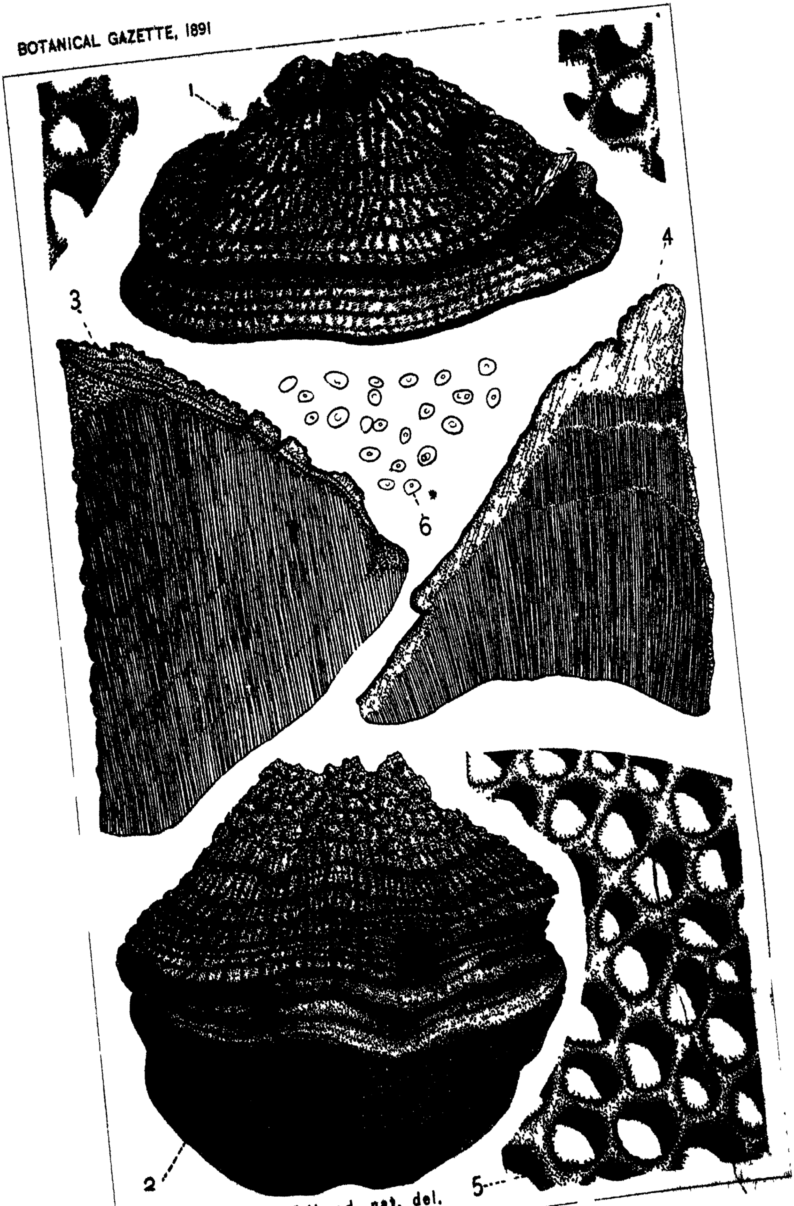
[1] The Copper-bearing Rocks of Lake Superior, by R. D. Irving.
[2] Owen's Report, p 621.

places. Once I came across *Camptosorus rhizophyllus* Link. It covered a space of a few square feet on some detached rocks in a deep shady nook beside a pond. This may be where Parry found it, since he gives as its habitat.—"Shaded and detached rocks, Falls of St. Croix." It was my first sight of this fern in the West, though I have often looked for it in favorable localities. The rocks on which it grew were trappean. It is generally, but not exclusively, credited to calarceous rocks. The only place besides this where I have seen it was in Western New York, where it grew in shaded places along the shelves of cliffs of limestone. In that pleasant little book of Williamson, "Ferns of Kentucky," he says of it, "It is found in all our Kentucky woods wherever there are detached moss-covered boulders, on outcropping rocks and cliffs either limestone or sandstone."

Another rare or local plant was gathered from the rocks above the village of Taylor's Falls, *Talinum teretifolium* Pursh. Houghton found it here in 1832. It is occasionally met with from Pennsylvania westward to Minnesota in our northern flora, being more common in Minnesota than elsewhere in this range of states. The Manual accords it as a habitat, "serpentine rocks," a much too restricted one. They are not of that character here, being diabase, though chemically, if this be needful, some of the same elements and their compounds could be yielded on decomposition. Upham, in the Minnesota Catalogue, says of the plant, "Rare, occurring only on ledges of rock, (trap, syenite, granite and quartzite)." I have found it but once before, in the silicious sands at Miller's, Lake Co., Ind. In Illinois it is found in "sandy prairies and barrens," as stated in Patterson's "Catalogue of the Plants of Illinois." At Taylor's Falls three other plants accompanied it on the trappean rocks, which are also found with it at Miller's, Campanula rotundifolia, Selaginella rupestris, and Cladonia rangiferina. All these do well in the sand. It shows that the Talinum would be easy to cultivate. Its flowers are pretty, though expanding late in the day and lasting but a short time; but its cylindrical leaves give it an odd though interesting look. It does not rival in the abundance of its flowers its congener from Central America, *Talinum patens* Willd., cultivated for platbands and as a basket plant, but would excel it in being hardy in our latitude, and might be used in a similar way, as well as for rockwork. As Vilmorin



ROSE on ASTER



F. W. ANDERSON, ad nat. del.

ANDERSON on FOMES

says of T. patens, "It keeps fresh in spite of heat and drouth, and will grow vigorously on unshaded rocks."[1]

Not uncommon on the rocks were specimens of *Houstonia purpurea* L. var. *longifolia* Gray. The characteristics were intermediate, allying it more closely to the type than ordinary examples of the variety; the leaves being sometimes three-ribbed and somewhat tufted or rosulate near the root. Several stems usually grow from the same root. The only plants besides calling for notice are, Oxybaphus nyctagineus, seen occasionally on the rocky banks, and Gentiana alba in springy ground.

(*Concluded next month.*)

Englewood, Chicago.

BRIEFER ARTICLES.

A new Aster from California (with plate XI).—**Aster Orcuttii** Vasey & Rose, n. sp.—Stems suffruticose, somewhat branching, pearly white, glabrous: lower leaves obovate, 1 to 2 in. long, with cuneate base; upper ones often oblong, with broad sessile or somewhat clasping base, obtuse at tip, spinulose-toothed, glabrous: heads solitary and terminal on leafy branches, sessile or nearly so, very large, an inch or more in diameter: bracts of the involucre closely imbricated in 3 or 4 series, oblong with tapering green tips ciliate on the margins: rays an inch long, "lavender to delicate mauve color": disk-flowers 4 lines long, tapering toward the base: style branches broad: achenes densely long white villous: pappus coarse and scabrous.—Collected at "Cariso Creek Wash," Colorado Desert, California (where it is very abundant), April and November, by *C. R. Orcutt.*—This handsome flowered species, although it resembles in habit and leaf some species of Aplopappus, evidently belongs to Gray's section MEGALASTRUM under Aster, and near A. tortifolius. It differs from that species in its almost sessile head, different involucral bracts, obtuse leaves, and larger disk-flowers. Mr. Orcutt obtained seeds of it and considers it worthy of cultivation.—J. N. ROSE, *Department of Agriculture, Washington, D. C.*

A new Fomes from northern Montana. (With plate XII).—**Fomes Ellisianus** Anders., n. sp.:—On the living trunks and larger branches of Shepherdia argentea, valley of the Teton, opposite the "Three Knees," buttes of the Marias river, northern Montana, July 1889. *Anderson, no. 537.*

[1] Les Fleurs de pleine Terre, p. 1124.

Pileus dimidiate, unguliform, 5 to 6 cm. thick, radiate-rugose and zonate; surface whitish and subpulverulent at first, becoming yellowish and glabrate, rimose, and finally of a dark, weather-beaten wood color; margin subobtuse or rounded, in the plane and concave specimens frequently with a distinct edge along its centre: pores stratose, sub-cylindrical, about three to a millimeter (including dissepiments), margins sub-acute, color at first white, finally creamy or faintly yellowish, fragile, easily bruised and rubbed off, leaving the surface ochraceous; surface concave, becoming plane or convex in age. Pores extending nearly through to the upper surface of the pileus, being covered above only by a thin (2–4 mm.) corky, pale-ochraceous layer. Spores hyaline, elliptical-globose or oblong, $5–6 \times 4–5\ \mu$.

In old specimens the annual layer of pores does not extend fully out, so that the margin of the pileus becomes broadly rounded, as described.

Related to *Fomes fraxinophilus* Peck, which species is thinner and broader, not rimose and with the pore walls thicker.

This fine species, Fomes Ellisianus, is very abundant in the Teton valley and doubtless throughout northern Montana and the northwest territory. Shepherdia argentea in these regions frequently grows in dense groves along streams and the fungus with its pileus the color of the host bark and pure white or creamy pore surface forms a striking and beautiful object. It is a pleasure to dedicate this species to Mr. J. B. Ellis, who has so generously helped me in my mycological work in Montana and elsewhere.—F. W. ANDERSON, *New York City*, Jan. 9th, 1891.

Silphium laciniatum L.—In the Botanic Garden of Harvard University two specimens of *Silphium laciniatum* L. have been cultivated for a number of years. Although these plants differ very noticeably in several particulars, Dr. Gray did not regard them as sufficiently distinct for separate systematic treatment. Sometime ago Dr. Watson kindly called my attention to the plants in question, and expressed the opinion that it would be well after all that they should be described, in the hope that botanists living where this well-known species occurs may observe whether or not these forms are constant enough to receive recognition as varieties. Acting upon this suggestion I have examined the plants and find they have the following distinctive characters:

NO. 1. Stem very rough, especially near the summit, where, together with peduncles and involucres, it is covered with bristly white jointed hairs, which are not at all glandular; leaves flat or nearly so, the upper cauline small, with narrow segments and inserted by a narrow clasping

base; the stipular appendages, which are present on the middle cauline leaves, deeply laciniate; involucral bracts rather rigid, acute, erect or spreading, seldom reflexed.

No. 2. Stem, peduncles, involucres, and bracts densely covered with a very short brown glandular pubescence with only occasional white jointed hairs; leaves not flat but. conspicuously curled or "crisped," the upper cauline larger and more numerous than in no. 1, sessile with very broad cordate clasping bases; stipular appendages of the others subentire or toothed, but not deeply laciniate; scales of the involucre long-acuminate, thinner than in no. 1, and nearly always abruptly reflexed. Blooms late in October, a month or more after the other. I have thus far been unable to detect any difference in the flowers, except that the rays of no. 2 are distinctly paler than no. 1.

Unfortunately it is not known from what localities the plants in the Harvard Garden were taken. On comparing them with the specimens in the Gray Herbarium, I find that the first is the more usual form; while only one specimen in the herbarium (from Lexington, Ky., collected by Short,) approaches nearly to no. 2.

It has long been recognized that S. laciniatum is subject to considerable variation in stem and foliage, and efforts have accordingly been made from time to time to separate as varieties or even distinct species some of the more remarkable forms of this polymorphic plant. In these attempts, however, the distinctions have been based chiefly upon such characters as the depth to which the leaves were divided, the paniculate or subspicate inflorescence, the presence of copious resin, etc., which have proved unsatisfactory for systematic purposes; since the division of the leaves, and character of the inflorescence are very variable, even in the same individual. It remains to be seen whether the characters here described will be found more serviceable. Most important among them, I think, is the nature of the pubescence, as there the difference is scarcely one of degree, but rather of kind.

As I hope to contiuue my study of the forms of S. laciniatum, I should be much indebted for specimens of, or facts concerning this widely distributed species. Information about the range of the glandular-stemmed variety (no. 2), or the possible occurrence of intermediate forms will be especially acceptable.— B. L. ROBINSON, *Cambridge, Mass.*, Dec. 1890.

The propagation of Ranunculus lacustris Beck & Tracy.—That little is positively known of the true length of time that this plant lives, is evidenced by the following quotations:

"Perennial by rooting from the nodes, if at all." (Gray's Manual, revised edition, under R. multifidus.)

"It probably lives about a year. The seedlings appear late in the autumn, along the banks and in the bottoms of dried up pools ready to make an early growth in the following spring." (Dr. C. E. Bessey, in American Naturalist, May, 1890.)

"On Staten Island, it certainly appears to be perennial." (Dr. N. L. Britton, in Bulletin of Torrey Botanical Club, July, 1890.)

My attention was attracted to the plant early in May, when I found it blooming in great profusion in this vicinity, many of the flowers being double. Its habitat, about Alma, is chiefly shallow ponds, made by the collection of surface water in slight depressions in the clayey soil of the region. These ponds are often dried up early in the summer in dry seasons, particularly since the forests have been cut off. During the latter part of May and throughout June, 1890, there was a long continued drought, so that by the middle of July, very many of these ponds were nearly or quite dry. About this time my interest in R. lacustris was renewed by the note in regard to it in the Bulletin of the Torrey Botanical Club for July, and I visited some of its favorite haunts to find out what its condition was at that season.

The date as recorded in my note-book was July 21st. The water of the pool was all gone, leaving a soft mud on the bottom and apparently no specimens of the plant alive. On closer examination, however, I found that the plants were there, but in a condition hardly recognizable. The floating stems were prostrate on the mud or partly buried in it, their finely dissected leaves dry and withered or entirely gone. The stems, however, were alive and green, and at the nodes were clusters of small leaves and budding rootlets. Even at this time there were many cases, in which parts of stems had disappeared and the new plants had established themselves. An interesting fact in this connection was the marked brittleness of the stems of the old plants — they broke very readily, so that it was hard to disentangle them from the mud and weeds without snapping them into bits. During the summer I visited the same and similar localities several times, and in a very little while after my first visit I found that all traces of old stems had disappeared, and that the young plants were making vigorous growth and might have been mistaken for seedlings. These plants rooted vigorously, sending out large clusters of threadlike fibrous roots and numerous petiolate three parted leaves, with cleft divisions. The petioles and under sides of the leaves were generally decidedly pubescent. Under the date, Sept. 15th, I find the following in my notes:

"These plants have continued to grow until, in many cases they are four or five inches in height, quite pubescent and in many places so crowded as to densely carpet the dry bed of the ponds in which they

grow." I was unable to decide whether the young plants sent out runners as soon as they were well rooted, but there were some indications that such was the case, as they became densely crowded in places where apparently there were but few specimens in the beginning. If there were such runners they soon disappeared and the plants stopped sending them out. Two other possible explanations suggested themselves to me; one, that such part of the stems of the old plants as were well covered with mud retained their vitality much longer than those not so protected, and appeared like runners, as the surface of the mud became drier and shrunk away; the other, that part of these young plants were seedlings, but if they were such their growth was exceedingly rapid, for the plants in given clusters were very nearly of the same size. At the date given above, the axes of the plants had not increased materially in length. The leaves were practically all radical and because of the crowded condition of the plants, long petioled. Shortly after the middle of September the fall rains set in, and water began to collect again in the ponds. At this time the stems began to grow, at first with very short nodes, but later, as the water became deeper, with longer ones. The greater number of plants sent out branches from the nodes of the stem even when the internodes were short. As the water grew deeper during the fall, the leaves which were submerged died and new ones, more finely cut, replaced them, and by the time the plants were entirely covered the foliage was as finely dissected as that of the aquatic flowering form. On the 18th of October I found two plants in bloom. The water had hardly reached them and the stems were trailing with rootlets projecting from the underside of the nodes. The leaves of these specimens were petiolate and between the dissected form of the aquatic plant and the cleft and parted form characteristic of the terrestrial plants of the summer. The flowers were somewhat smaller than the usual aquatic ones. On my last visit made late in November, just as the ice was beginning to form, I found that the depth of water in the ponds had materially increased and that the submerged plants had made strong and rapid growth, and were entirely typical in foliage and other particulars. The summer leaves were all dead and brown, while the new ones were green and vigorous. Some plants which I had transplanted above high water mark, were still living, but showed no marked growth as in those under water, and the leaves were unchanged. From these considerations, if we consider the observed conditions of growth and propagation normal, and there is no evidence to the contrary, our plant is truly perennial, since the old stems live long enough to nourish and thoroughly establish the plantlets which develop at their nodes

after the flowering season is over.—CHAS. A. DAVIS, *Alma College, Alma, Mich.*

Cornus Baileyi C. & E. in Oregon.—In the revision of Cornaceæ (Coulter and Evans), under the discussion of the relationship of *C. stolonifera* Michx., *C. pubescens* Nutt., and *C. Baileyi C. & E.*[1] the prediction was made that C. Baileyi might be found along the Pacific coast and its ranges, where it had descended from its already known habitat of British America, and that it would be confounded with C. pubescens. Such has since proved to be the case. In a package of plants recently received from Messrs. Drake & Dickson, Portland, Oregon, there was found an undoubted specimen of C. Baileyi from Castle Rock, Columbia River, Oregon, bearing the date June 1889 as to flowers, the fruit evidently being of later collection. As in the east, C. Baileyi has been confused with C. stolonifera on account of the presence of some appressed pubescence, so here it had been labeled C. pubescens, evidently on account of the rather loosely pubescent under surface of the leaves. But an examination with a lens showed the presence of both appressed and wooly pubescence, such as is found in C. Baileyi and not in either of the others. The stone in this specimen is nearly twice as broad as high, is prominently flattened, has the square-shouldered top of typical C. Baileyi, and has its rather deeply furrowed edge. This combination of characters can leave no doubt as to the occurrence of C. Baileyi on the west coast. It is highly probable that forms may be found not so well defined as this one, and the presence of all three of these nearly related species will give more or less trouble when approaching each other, yet the extreme forms should give no cause for difficulty in determination.—WALTER H. EVANS, *Indianapolis, Ind., Herbarium Eli Lilly & Co.*

NOTE.—A private letter from E J Hill, of Englewood, Ills , makes the following statements concerning C. Baileyi "My first note on it was in Sept. 1875, and it was called C stolonifera But studying this lake shore shrub in other years it seemed C sericea, but the fruit was not colored rightly It was too ruddy a shrub for C. paniculata, and so has remained a source of doubt till your characterization appeared. Noticing them the other day (January) while taking a trip in the Pine Barrens, the color of the canes of the two contrast considerably. When the leaves are off, we get the color to the best advantage Those of C. stolonifera are very bright red and glossy in winter, of a hue almost crimson, while those of C. Baileyi are duller, a little of the brick-red cast. I think one could be pretty sure of identity in the winter, from this character alone." J. M. C.

---

[1] Bot. Gazette, xv. pp. 38 and 88.

EDITORIAL.

THE UTILITARIAN side of botany is one that is not attractive to the majority of botanists, unless it be in that intensely personal way embodied in the retort of a Harvard professor when annoyed by the inconsiderate question of a visitor to whom he was showing an object under the microscope. "And what is the use of it all", said the visitor. "It brings me my bread and butter", was the quick reply. It is to be feared that there are botanists who would feel that the science was sufficiently recognized if a proper number of places with comfortable salaries attached were provided for deserving aspirants, who might retire from the distractions and contamination of the world and devote their lives to pure science without being prodded into giving a thought to any possible application of their results to the practical affairs of life. Such positions are never likely to be numerous. In the meantime the world is clamoring for chemists and electricians and representatives of other departments of science to stand as sureties that capital shall not be misdirected. The increasing variety and complexity of the requirements makes evident the necessity for a more complete knowledge of the principles involved, and thus a return road is open to original investigation. This not only means a readier recognition of the value of the science, but increased tolerance for its more abstruse phases that appear to have no present relation to commercial life.

MEDICINE WAS the first patron of botany, and in foreign countries is still one. The early botanists were physicians, and studied plants to discover their medical properties. The first botanic gardens were founded with this purpose in view. Afterward came the study and cultivation of plants brought together by travelers and explorers with the expectation of an increase of the natural productions upon which commerce thrives. This is especially marked in the maritime nations, such as England and France. It is the principal motive for the maintenance of the Royal Gardens at Kew. In America, neither of these interests have much affected the growth of the science. In fact, not until recently has botany been much called upon to lend material aid to the development of the western world. This time it is agriculture that lends a hand, and it has come largely through the establishment of the agricultural colleges, the agricultural experiment stations and the section of vegetable pathology in the Department of Agriculture at Washington. However, none of these gave the initiative to the present train of thought. It came from a visit to a large pharmaceutical establishment at Indianapolis, in which a professional botanist is

employed, with facilities for doing good work both for his employers and for science. Why may we not hope that other and various kinds of commercial enterprises may find it profitable to make use of the services of well trained botanists? The science is not likely to lose anything by it, and there are possibilities of considerable gain.

CURRENT LITERATURE.

Minor Notices.

EDUCATION for March contains an article by Prof. Conway MacMillan in which the evils of the common three-months course in botany are vigorously exposed, as they have been many times before, and will need to be many times more. The theme is an inexhaustible one and the remedy proposed will be as polymorphous as the writers are nuerous. For example: in our judgment the remedy lies in the education of the teacher and not necessarily in the change of course.

BOOKS ON the diseases of plants are increasing. The third one in the English language has just been issued, and imitates its predecessors in form, size, and in its British origin. The work is by Dr. A. B. Griffiths,[1] and deals with the injuries to plants brought about by plant, animal and other agencies. A large number of plant affections are treated in a very brief manner, and in most instances a cure or preventive is given. Two drawbacks to the usefulness of the work are prominent: the inadequate accounts of the maladies, and the rather antiquated character of part of the information that is included. The author has made a praiseworthy attempt to provide (suggest does not seem to be the right word) remedies and preventives, but they are largely founded upon general principles, such as: destroy all infected plants, apply a solution of iron sulphate, topdress the land with gas-lime or quicklime. England is far behind the United States in the knowledge and use of specific remedies for plant ailments.

DR. ROLAND THAXTER has issued a supplementary note (Proc. Am. Acad. p. 261, presented Jan. 14, 1891) to his former paper on N. Am. *Laboulbeniaceæ.* The additions of a single season have been so unexpectedly large and important that it has been thought wise to defer the promised monograph. With the present additions, the species of

[1]GRIFFITHS, A. B.—The diseases of crops and their remedies: a handbook of economic biology for farmers and students. pp. 174. Illustrated 12°. London: George Bell & Sons, 1890. 2s. 6d.

this family in North America already outnumber all the known exotic species. A remarkable new genus *Zodiomyces*, is described, and forms a distinct departure in the group. *Hesperomyces* is another new genus; while *Peyritschiella* receives a new species, and *Laboulbenia* six.

WE HAVE RECEIVED the advance sheets and plate proofs of Ellis & Everhart's North American Pyrenomycetes. The illustrations are all original, the drawing having been the work of Mr. F. W. Anderson. There are 41 plates, each one accompanied by a page of explanatory text. We understand that 4 more plates will be issued as a supplement. In looking over the plates it is evident that the volume will be a boon to American mycologists, and that this large and rapidly increasing group of botanists will warmly welcome its appearance.

OPEN LETTERS.

Mounting plants.

THOSE WHO have had experience in mounting plants for the herbarium will readily understand why Prof. Beal should "decidedly favor" fastening down grasses with gummed strips, for of all things grasses are the most refractory subjects to glue down, and unless the work is expertly done and the stout culms immediately stayed by strips (without waiting for these to "spring up" before being "patched up,") there is likely to be displayed all the defects and drawbacks which our friend specifies. But it has occurred to me that notwithstanding Prof. Beal expressly restricts his remarks to the "mounting of grasses and allied plants" there might be some who would construe them into a qualified condemnation of the glue process from beginning to end. This, I take it, was not intended. Excepting the grasses there is not another large order of plants which the writer, for one, would not much prefer glued down; the Compositæ, Leguminosæ, Rosaceæ, Umbelliferæ and even the Cyperaceæ. A delicate Astragalus or Vicia can be neatly and expeditiously mounted so that every flower and leaflet in contact with the sheet will be securely fastened and that, too, without showing a particle of "surplus glue" to mar the perfection of the work; the same may be said of all the Umbelliferæ, but more especially of those with finely dissected leaves; while as for the Compositæ they are so easily glued down, held so firmly, look so well after the work is done, are so convenient to handle and easy to study, I can not concieve of two opinions being entertained as to the preferable mode of mounting them. Were the objection that specimens "not mounted right side out" can not be turned over, really as formidable as it appears in the statement it would have long ago led to the abandonment of gluing down. As a matter of fact I do not recall, in thirty years' experience, having ever been balked by a specimen mounted wrong-side up. Nor does gluing prevent the detachment of small fragments for more careful examination with the aid of those capital help-

ers the cup of hot water and low power microscope. It is a poor and meager specimen, indeed, from which such little bits as are required for this purpose can not be taken without injury, but even this will be obviated when collectors learn to preserve surplus flowers, fruits, etc., for subsequent dissection.

Much has been said, one time and another, about the convenience of loose material for study, with the implication that mounted material was inconvenient just in proportion to the security of the attachment to the harbarium sheet. For my own part I avoid, as much as possible, handling loose specimens, and *for study* prefer things securely mounted. My mind is then relieved of any undercurrent of care lest labels or specimens get misplaced, I find open spaces left on the sheet for any sketches or analyses that I may care to make, and the identical fragment had under examination can be placed in a pocket alongside to attest the accuracy of the drawing. Notes can be written down and all this will remain while the sheet lasts as certainly appertaining to the very specimen made the subject of study. I can go so far as to mark with a little × the precise spot in head, spike, ament or what not, from which I detached my fragment for examination. For effecting such detachments with a minimum of injury to the specimen I use a tool painfully suggestive of a dentist's outfit, but really of more agreeable antecedents, a fine little chisel made by breaking off the hook of a steel crochet needle and then sharpening the end to a crosswise edge. The long handle gives a firm hold, the cutting edge is very narrow and with a steady thrust, under a lens, one may cut just the part desired without bringing away, unintentionally, ten times more than is wanted. — M. S. BEBB, *Rockford, Ills.*

NOTES AND NEWS.

REV. FRANCIS WOLLE'S "Diatomaceæ of North America" has just been issued. It contains 2300 figures and 112 plates.

IN THE *Public Ledger* (Feb. 19) of Philadelphia Mr. Thos. Meehan has published a long and interesting account of Rafieesque.

IN THE article of Dr. Homer Bowers on Hydrastis Canadensis, which appeared in the March number, the following corrections should be made: p. 76, 9th line from bottom, "inclines" should read "inclined"; p. 77, last line, erase "not." This last is naturally a very important correction.

UNDER LEAVE of absence from the University of Wisconsin Prof. Chas. R. Barnes will spend the time from April to September at Cambridge as assistant in the Gray Herbarium. It is the intention of the director, Dr. Sereno Watson, to have the important bryological collections rendered available to students as soon as possible. The initiation of this work together with the revision of the Field, Forest and Garden botany which is in progress, will occupy Prof. Barnes' time. Correspondents will please note the change of address.

VOL. XVI. NO. 5.—BOTANICAL GAZETTE.—MAY, 1891.

On raised peat-bogs in New Brunswick.

W. F. GANONG.

In certain places near the sea-coast of Charlotte and St. John counties in the Province of New Brunswick there occur several large peat bogs, composed of the purest Sphagnum, which have their centers raised many feet above their margins. Such raised bogs must be exceedingly rare; indeed, Professor W. G. Farlow tells me that he has heard of but one other instance, which was in the case of a raised bog in Sweden described in a botanical journal some years ago. These in New Brunswick then must have a special botanical interest.

These bogs having come of late locally into notice for reasons to be referred to below, the present writer, who like many another botanist enjoys in his native place a reputation for omniscience in matters botanical, was called upon last summer to explain their origin. Not being able to do so, he found his natural and securest refuge in the usual resort in such cases, an habitual expression of scepticism (in this case nearly as much real as assumed) as to their very existence. All such refuge, however, was closed to him when, in August last, he, that is to say I, made a visit to one of them in company with a well-known enthusiast on peat bogs and skilful exponent of other local wonders, Mr. C. E. Boardman, of Milltown, New Brunswick.

The one we visited was near Seely's Cove, in Charlotte county, N. B., some twenty miles in an air line N. E. from Eastport, Maine. This bog lies on the right of the highway as one approaches the coast, and is over a quarter, perhaps half a mile in length. It is relatively narrow, being not more than one-sixth of that distance in breadth, perhaps less. It lies in a general N. and S. direction, nearly parallel, at its upper part at least, with the highway road, and therefore with the high land. It rises gently from the margin all around until it attains a height of about ten feet, when it slopes still more gently, probably four or five feet higher, and then becomes flat topped, and so runs for the above mentioned length. Its section would present about the curve of a loosely strung

bow which bends rather abruptly toward tl.. ...... Its surface is entirely naked and clear of trees and shrubs of any kind with the sole exception of an occasional very much dwarfed blueberry bush; and according to local tradition it has always been so. The same authority, it may be added in passing, says that it is growing in height; basing the statement upon the observation that teams and people at the lower end, which could formerly be seen from the upper, cannot now be so seen, a point not likely to escape notice in a sparsely-settled district where the doings of one's neighbors are of so much moment.

The bog is composed of nearly pure Sphagnum of the finest kind, free from all roots and similar impurities and showing not a trace of decay or anything resembling muck. Some few other mosses and lichens occur on the surface, but appear to form no part of the material below. The living material above merges gradually downwards into a clear, odorless, carbonaceous, semi-peat like material, which has been found to have important economic properties dependent upon those qualities. It is soaked with an abundance of water, clear and cold, and hence totally unlike ordinary bog-water. Its clearness was plain to the eye as it flowed from a squeezed handful of the moss, its coldness to the senses, both by its feeling when a hand was thrust into it, and also by the satisfactorily refrigerated condition of the liquid portion of our luncheon which was buried in it for a time to await our return. The bog does not tremble under foot. It is bounded on one side only by high land, and on the other it slopes down and merges into a flat bog of the ordinary kind which is of great extent. The latter presents all the ordinary bog characters, dirty water, muck, trembling places, and a growth of clumps of small spruces and the ordinary ericaceous shrubs; in fact it is the common every-day bog we all know. It is a novel and pleasing experience to walk from the dirty quaking affair up a slope to one so clean and compact.

My guide, with his veracity fully vindicated, was of course triumphant, and he gave me many details as to others, the principal of which he has had the kindness to repeat in a letter. His business during the past two years has taken him over every part of this section of the country; and as he has been specially on the look-out for the bogs, his observations are valuable. In all he knows of sixteen bogs of considerable

size, of this raised character, the areas of which vary from a few up to three hundred acres, the total acreage of all sixteen being estimated at about eleven hundred acres. They vary in height from a few feet up to as much as forty or fifty. They are all comprised within a limit of about thirty miles, between L'Etang Harbor and Musquash; and although a careful search has been made for others in other parts of New Brunswick and in Maine, none has been discovered. They are all near the coast, with only two or three exceptions being within two or three miles of the salt water, only one of them being as far as four miles away. Very few of them have any level bog portion. They are all entirely clear of trees or bushes, and composed of clear, clean Sphagnum. In one or two cases Mr. Boardman has bored to the bottom of the smaller ones and found them underlaid by clean gravel; in other cases the boring apparatus, adapted to go down twelve feet, did not reach bottom, and it brought up in all cases only close clean carbonized peat-moss, with no trace of muck. At Musquash one of the largest, though not a very high bog, is being extensively worked for the moss, which has been found exceedingly valuable as a bedding for horses and cattle. The workings have there gone to a depth of forty-four feet without finding bottom or muck impurities. The great purity, freedom from decay, antiseptic and absorbent powers of the carbonized moss promise to create a local industry of much importance; and practical men are there putting energy and capital into mining and experimenting with it.

Lest my readers, habituated to the appendage of a theory to all statements of facts, should experience a shock by its absence, I hasten to be in the fashion and offer my "theory" of their origin. I can speak personally only of the Seely's Cove bog, but possibly what is true of it may apply to others also. I think its origin and growth are connected with the great prevalence in this region of large, clear, cold springs. In fact there occur a few miles away single springs which are large enough to give origin to large brooks, and the water is invariably very cold and clear. A most famous spring of this character occurs on the line of railway a few miles from St. George and smaller ones are abundant everywhere. The purest water I ever saw, even in New Brunswick, where so many streams are crystal-clear, was in a spring brook within a mile or two of this bog. Now it is noticeable that the upper

end of the bog comes in contact with the high land, and that it is for some distance parallel with it, that it is long and relatively narrow, and that on the side away from the higher land it sinks down to a large bog of the flat kind. I think it extremely probable that a huge cold spring (or a line of them) comes out from the high land at the upper end of the bog, and the water then flows along toward its lower end on the bottom, being soaked up as it goes. The bog then grows and carries up the water sponge-like with it, and when off to one side the influence of the spring diminishes and is finally lost, the ordinary bog conditions begin to prevail. All this is confirmed by the fact of which Mr. Boardman assures me, that there flows out from its lower end a brook of clear, cool water, large enough so that in times past it has turned the wheel of a mill. Water of this character does not flow from common bogs and a spring origin seems necessary to account for it.

One other point remains to be explained. Why are they treeless and shrubless? This I believe to be due to the coldness of the water supplied by the springs. The temperature is too low for the growth of the roots of shrubs or trees. Its coldness has been already referred to; even at a depth of but a few inches this was very marked. It is perhaps, too, a point of importance that the bog bears in greatest profusion the cloud-berry, *Rubus Chamæmorus;* so abundant is it that the inhabitants resort to the bog with pails and gather it in great quantities. This northern plant finds so congenial a home but rarely in these latitudes, and seems to point to the cold conditions prevailing in the bog. I advance this explanation but tentatively. Perhaps some of our botanists who take their outing in that favored region will give it their attention.

Harvard University, Cambridge, Mass.

Notes on the flora of the St. Croix region.

E. J. HILL.

(Concluded from p. 113.)

The rest of the time in the St. Croix region was given to the Chesago Lakes, situated a few miles west of Taylor's Falls. Three days of the early part of September were mainly devoted to an examination of the water-plants, or to those of

the immediate shore. The body of water designated as above, or more often in the singular number, is made up of three principal sheets of water joined by narrow straits, and with numerous small bays indenting from its shores. On a tongue of land projecting from its eastern side is the village of Center City, the county seat of Chesago county, ambitious in name but diminutive. This was my stopping place, in the midst of a population almost wholly Swedish. There were fine farms around, and the many goodly farm buildings showed thrift and comfort. When one strolled into the fields and woods, there was a strong reminder of Ohio and New York in its better cultivated parts, though the hills were lower, and the beech, the chestnut and the tulip-tree were noticeably absent from the woodlands. But most of the other trees were there, the maple in abundance; and all the humbler plants, the asters, and goldenrods in the corners of the crooked fences, and those spared by the sheep and cattle feeding in the woods, had a familiar look.

The lakes and ponds abounded in species of *Potamogeton*. The shallower and more sheltered parts were covered with pond-lily plants, Nymphaea reniformis and Nuphar advena. Allusion has been made in a former article to the quantities of *P. Robbinsii* here. It almost filled the water in some places to the exclusion of other plants. The season was late for good specimens in fruit, as most of it had fallen off, but some was obtained in good condition. *P. prælongus* was also very abundant in deeper water, taking other areas quite to itself. So it may be said of *P. perfoliatus*, var. *lanceolatus*, and *P. pectinatus*, in places most suitable to their growth. Along the west side of a long point of land extending south from the railway station, *P. Spirillus* was sparingly found. I had not before seen it at the West, where it seems rare and local. One more station has been given for it in Minnesota, Prof. L. H. Bailey having found it in Long Lake, in the extreme northeastern part of the state, in 1886. I have not met with it in Michigan. Wheeler and Smith in their Catalogue of Michigan Plants credit it to the Upper Peninsula on the authority of Gray's Manual, the entry being "Lake Superior." But this is very general, and may be outside of Michigan, though there is no reason to question its presence in that state, except its rarity and the indefiniteness of the locality. Dr. Vasey has found it in northern Illinois, in McHenry coun-

ty. This and the two stations for Minnesota are the only ones concerning which I have definite information for the Upper Mississippi and the Upper Lakes within the bounds of the United States. P. Spirillus is a common plant in some of the small lakes of western New York. Those I have seen there were generally furnished with well developed floating leaves. In the few specimens seen in Chesago Lake, the floating leaves were rare, the plants being almost always entirely submersed. It probably occurs in other parts of the lake, but time was lacking for a thorough search. My experience shows that the habitat assigned to this plant in Gray's Manual is too exclusive in character. I have heretofore found it in small lakes, not in streams. It grows along the shallow margins of these lakes, taking the shelving beach from where the water is about a foot and a half in depth to where it shallows to three or four inches. In the latter situations it may be left bare of water for a time when the winds blow off shore. Under such conditions it grows in tuft-like masses, with short and very leafy stems, being little more than a bunch of leaves.

Some of the plants of the shore were of considerable interest. *Sagittaria heterophylla* Pursh bore stamens the length of whose filaments allied it to the section containing S. variabilis more than to that containing S. heterophylla. They were two or three times as long as the anthers, but had a lance-ovate, very glandular base. Some of the leaves were sagittate with narrow appendages. The beaks of the fruit were turned to one side, and could hardly be called erect. *Juncus pelocarpus* E. Meyer grew in the wet sands of the shore. *Cyperus Engelmanni* Steud. had spikelets considerably flattened, or quite far from terete. *Hemicarpha subsquarrosa* Nees, generally but an inch or two high, was abundant in some places. Its scales were barely recurved at the point. Nearly all of the culms bore one or two small additional involucral leaves.

The most interesting plant of the wet shores was *Scirpus debilis* Pursh. Its flowers were uniformly characterized by two stamens, no exceptions being found as far as they were examined, and this extended far enough to establish the fact as a rule. The style was two-cleft, and all the bristles usually longer than the achenium. This was somewhat plano-convex, broadly obovate, thick, rugulose, shining, from dark brown to black in color. The stems were convex on one side

and grooved on the other, a cross section being meniscoidal rather than grooved-triangular when the stems are fresh. It was exceptional to find the involucral leaf horizontal at maturity. The stems grew in quite large tufts, much like Eleocharis obtusa in habit. They were from six to fifteen inches long, frequently recurved or prostrate. Though variant from the species as described, it hardly seems separable from the type, as the number of stamens either in Scirpus or Eleocharis is not constant. The present season (1890) I have found essentially the same form in two places near Chicago, at Millers and Dune Park, Ind., in the Pine Barren region. These are stations on the Michigan Southern R.R., about five miles apart, and the plants were obtained from the wet sands of the ditches skirting the railway. Considerable pains were taken to see if the flowers had more than two stamens. A dozen clusters of spikelets were selected, generally from stems borne on different roots, and three or four flowers from each cluster were examined. The style proved uniformly two-cleft, and the stamens two in number. I looked in vain for an exception, but would not affirm that it may not be found. This seemed the more curious, because in 1877 I collected S. debilis of the typical form only a few rods from where it was found this year at Miller's. It was along a roadway in a field beside the railroad. It was sought again in the same locality, but in vain, the grass having supplanted it, or the grazing cattle having destroyed it. An examination of the dried specimens shows that they have flowers with three stamens. It is doubtful whether the two sets of gatherings from these contiguous spots on different years are of the same group, for this constancy of difference would hardly be expected. But those of 1890, though much farther apart, are referable to the same group, since they are from the ditch along the same side of the track, though this is not continuous, being crossed or interrupted by some low ridges. But plants readily spread under such conditions. In other respects the plants were quite like those from Chesago Lake.

In the wet sands near the station at Center City *Ranunculus Flammula* L. was frequent. The stems are ascending or erect, from three to five inches high. The lower leaves are linear to oblong-linear, and from one to two inches long. The flowers are from one-fourth to one-third of an inch in diameter, with five to seven petals. This is the second time

I have come across this form of the plant, having previously seen it under similar conditions of growth at Escanaba, Mich. Upham gives Minneapolis as another station for it in the state. Its range in Gray's Manual is given as "shore of Lake Ontario, and northward." As the Manual is for the United States I suppose this means the southern shore. Macoun gives it for the Canadian shore, and "the gravelly banks of rivers to lat. 69° (*Richardson.*)" The Michigan and Minnesota plants are interesting as extending the geographical range farther up the Great Lakes and into the region of the Upper Mississippi. The plant evidently conforms to the var. *intermedius* in the Manual. The conditions of growth may have something to do with the erect or semi-erect habit of the stems. In both cases where found these were carefully noted and compared with those of var. *reptans*, the common form. I have always found the latter in open places, in sand or gravel quite bare of other vegetation, or with plants low or creeping like itself, and not shading it. In the var. *intermedius* the plants grew among scattered spears of grass and rushes, considerably overtopping and shading them. It could not easily lie on the ground and root at the joints, though there is sometimes a tendency to this in the lowest joint or two. The erect or ascending stems—the latter the more common position—are so slender that they could hardly support themselves if deprived of the shelter and protection of the surrounding plants, and forced into the conditions of the creeping stemmed variety. They often lean against these plants as if too weak to stand alone, and are apparently struggling upward toward the light.

Englewood, Chicago.

A visit to the West Indies.

A. S. HITCHCOCK.

The readers of the GAZETTE may be interested in a few of the observations made during a recent trip to the West Indies.

The expedition was organized and conducted by Dr. J. T. Rothrock, of the University of Pennsylvania, in whose yacht, the White Cap, we lived during our absence from the United States. We started from Fernandina, Florida, Nov. 4th,

1890, and returned to the same port Jan. 29th, 1891. Our vessel, a yawl-rigged schooner of fifty-one tons, was commanded by Capt. Freeman Boynton, an experienced navigator in the West Indian region. The party consisted of Dr. Rothrock, D. J. Bullock and J. P. Moore, of Philadelphia, and the writer.

The month of November was spent cruising through the Bahamas of which group, we visited New Providence, Eleuthera, Cat Island, Watlings, Crooked Island, Fortune Island and Great Inagua.

Excepting Inagua the islands are quite similar in geological and floral characters. Over the coral limestone are scattered thin patches of soil which have collected in the depressions, the larger and deeper of which are termed banana holes. It was surprising to see so much vegetation growing from so little soil. But the ligneous flora consists mostly of shrubs, eight or ten feet high, while trees of even moderate height are uncommon, although Andros is said to be thickly wooded.

The land owners are at present greatly interested in the cultivation of Sisal hemp,[1] the fiber of which promises to become an important production of the islands. The plant is admirably adapted to thrive on the almost soilless rock, where few other economic plants would grow. When a plantation is once established successive crops are taken from the same plants.

The pine-apple[2] is cultivated more or less throughout the islands but chiefly on Eleuthera, where the peculiar red soil, which is best fitted to produce the finest fruit, is found in greater abundance. No fertilizer had been used, and the growers found that the soil, strangely enough, was wearing out, with no virgin soil to draw upon. This result will come about in time, even in a tropical country, especially where the soil is thin. But now a chemical fertilizer is imported from the United States and the land is yielding large returns.

The cocoa-nut[3] is cultivated everywhere especially near the sea-shore, where it finds the best conditions for its growth. The milk of the nut is very refreshing to a thirsty traveler. Many a time, on a hot day, when oppressed by the heat, I

---

[1] Agave rigida Mill. var. Sisalana Engelm. Acad. St. Louis, iii. p. 316. (For article on the industry, see Northrop, Pop. Sci. Mo. Mar. 1891.) The names following are those used in Grisebach's Flora of the British West Indies.

[2] Ananassa sativa. (Bromel.)

[3] Cocos nucifera. (Palm.)

have made my way into a plantation, found a tree where the nuts were within reach, cut one off and with my machete, slashed away a portion of the thick husk surrounding the nut, made an opening through the shell, and quaffed the cool and pleasant flavored liquid within. The green cocoa-nut contains only milk, but as it ripens the "meat" deposits around the interior, at first soft and nearly tasteless, but finally hard and sweet as in the nut of our markets. While the meat is yet soft it is much relished by some, but to me it was insipid.

At Crooked Island we saw the French wells, which are cut in the solid rock scarcely above the sea level, and some half buried cannon both of which are supposed to date back to the time of the buccaneers. Along the shores we saw innumerable piles of conch shells, each with a small hole broken in the end, where the conch had been pushed from its fastening by the fishermen. The flesh, which to me tasted like boiled leather, is much esteemed by the natives.

The southern islands of the group yield large quantities of salt. Sea-water is run into shallow ponds, each owner having his portion partitioned off by a stone wall, where it is evaporated by the sun. The residue is scraped into large heaps near by, where it is allowed to remain exposed to the sun and rain, apparently without serious loss.

Inagua differs somewhat from the other islands of the group. It is larger, more nearly circular in outline, and has a deeper covering of soil. There is a more decided change in the flora, Florida types being replaced by those of Cuba and Hayti. Grass land is comparatively abundant, affording pasturage for stock. In the interior of the island are savannas which appear to be dried up salt marshes. The experience acquired during a trip to this region will furnish our party with ample material for mosquito stories during the rest of their lives. The little pests were simply intolerable. As we walked along they flew up in clouds from the grass, biting through our clothes and even crawling up our sleeves for a good drink of our rich northern blood. No doubt the recording angel, that day, was obliged to devote considerable attention to Inagua. I tried smearing the exposed parts with oil of pennyroyal and vaseline, as has been recommended, but it was of little avail against Inagua mosquitoes. On the other hand, while in Jamaica we were not troubled by insect pests of any kind, except, in certain localities, by the ticks.

Nor were we nearly so uncomfortable from the heat, as in the Bahamas.

The trees in common cultivation through the Bahamas are poinciana,[4] with its long pendent pods and feathery foliage, which is deciduous in January; the almond,[5] easily distinguished at long distances by its flat-topped, imbricated foliage; "cedar",[6] sand-box,[7] and, of course, the cocoa-nut and banana.[8] The silk-cotton tree,[9] or "big tree" as the inhabitants have christened it, near the post office at Nassau, figured in Garden and Forest (vol. iii. p. 347), is a magnificent specimen, but is peculiar in being low and wide-spreading instead of tall and proportionately more slender as is usually the case. In Jamaica it is one of the tallest trees of the forest, sometimes rising a hundred feet to the first branch. It is used extensively for making canoes, which are hollowed out from a single log, but is of little value otherwise.

The silver-top palmetto[10] occurs abundantly throughout the Bahamas. It is used by the natives for thatching their huts; and also for making hats, mats, baskets, ropes, etc., for which purpose the central unexpanded bunch of leaves is employed.

After leaving Inagua, we sailed for Kingston, Jamaica. During our six weeks stay on this beautiful island we visited, after leaving the capital, Port Morant, Port Antonio and Lucca. The party made a most delightful trip to the summit of Blue Mountain Peak, distant from Kingston twenty-one miles. The journey to Gordantown, about half way, was made in carriages, the remainder on horseback, our provisions and apparatus being carried on pack mules. Although midwinter, flowers were abundant, as were ripe strawberries, which we picked and ate with relish. Above 5,000 feet, approximately, tree-ferns[11] appeared and gave a decided tropical look to the forest. Blue Mountain Peak reaches an altitude of about 7,300 feet, the highest point on the island. The temperature at noon was 55° F., but it is said that ice occasionally forms. From 2,000 to 4,000 feet elevation coffee and

---

[4] Poinciana regia. (Legum.)
[5] Terminalia Catappa. (Combret.)
[6] Casuarina equisetifolia. (Ament.)
[7] Hura crepitans. (Euphorb.)
[8] Musa sapientum. (Musac.)
[9] Eriodendron anfractuosum. (Bombac.)
[10] Thrinax argentea. (Palm.)
[11] Cyathea arborea. (Filic.)

cinchona plantations are frequently seen. We saw several more or less ruined drying-floors which were formerly used for drying the coffee. These were made by paving or cementing a square of level ground in a sunny situation.

As has been noted by most travelers in tropical regions the most striking feature of the vegetation to a person coming from the north, is the varied character of the flora. One rarely sees areas in which one species is conspicuously predominant. No one type is able to exclude others by force of numbers as in temperate climates. Another effect is the extension of the flowering season of a given species. There is to be sure, a season during which most of the flowers are produced, but one is almost sure to find stragglers in bloom at all times of the year.

Compared with the central United States, we find in Jamaica several exotic orders largely represented, as Malpighiaceae, Melastomaceae, Myrtaceae, and Piperaceae. Others of which we have but a few outlying members are there in abundance; as, Apocynaceae, Acanthaceae, Rubiaceae, Laurineae, Aroideae and the genera Solanum, Ipomoea and Croton. One cannot fail to observe also the more familiar orders Malvaceae, Leguminosae, especially Cassia and Mimosa, and a great variety of ferns. Ferns in the swamps; ferns on the arid rocks; ferns that are epiphytes; ferns that are climbing, either on trees by rootlets, or over bushes on by recurved spines; ferns of all sizes and shapes from the great tree ferns with fronds ten feet in length down to the wee species, an inch long, growing in the moss on its trunk. Aroideae will also attract attention, especially large leaved Philodendrons, climbing the tallest trees, and sending down long air-roots, which hang suspended like ropes, in fact they are used by the natives instead of ropes. The innocent looking Canna-like, but much dreaded, dumb cane[12] is another interesting member of the order.

Orchids are abundant, especially the epiphytic species. To see great bunches of these, many kinds in full flower, and the assortment of Tillandsias, or wild pines perched all along the branches of a half dead mango or silk-cotton tree, is a beautiful and, to the collector, usually a tantalizing sight.

On the other hand many orders, large at home, are scarcely represented in Jamaica; as, Ranunculaceae, Cruciferae, Caryophylleae, Rosaceae, Umbelliferae and the genus Carex.

[12] Dieffenbachia Seguine. (Aroid.)

Even composites are scarce. Of Cacteae I observed *Opuntia Tuna* common along the coast; *O. coccinellifera* and *O. Ficus-indica*, introduced around dwellings, *Melocactus communis*, in arid places; *Cereus grandiflorus* and one or two other trailing or climbing *Cerei; C. Swartzii* and *Opuntia spinosissima*. The last two species were particularly abundant on the palisades, an extremely sandy tongue of land, at the end of which is Port Royal. *O. spinosissima* sometimes grows to the height of 25 feet and is truly a tree cactus, the straight and frightfully spiny trunk being crowned by a spreading or pendent series of oblong joints. C. Swartzii (botanically so called in Jamaica) also grows to the height of 25 or 30 feet and has the habit of C. gigantea. It is used extensively for hedges, being planted very close and kept trimmed to a given height. Another hedge plant much used is the Pinguin.[13]

Euphorbia antiquorum is introduced in many places, especially in the Bahamas, and where established, often occupies considerable area to the exclusion of everything else, forming a prickly and impenetrable thicket ten or fifteen feet in height.

On Eleuthera and some of the neighboring islands grows a species of *Agave*, with the flower stalk 25 or 30 feet high. This is, curiously enough, called "bamboo" by the natives.

The real bamboo is extensively naturalized in Jamaica, and is used for a variety of purposes. Many of the huts are made by weaving the split bamboos into upright posts and thatched with "cane" (sugar cane) or wild cane.[14] Baskets and other small articles are made from the finely split culms; drinking cups and other vessels from the closed joints; fences, including the posts, are largely made from this grass.

To me one of the greatest curiosities of the flora was the mangrove[15] swamps. These have been frequently described but must be seen to be appreciated. We saw a very fine grove at Port Morant, at the head of the bay and lining each side of a small river which enters it at that point. From the outside it presented a most beautiful bank of glossy, dark-green leaves, reaching to the water's edge. Inside, however, one sees about as dismal a view as can be imagined. The trees all perched on spider legs, through whose intricacies a

---

13 Bromelia Pinguin. (Bromel.)

14 Arundo sp. (Gram.)

15 Rhizophora Mangle. (Rhizoph.)

man could scarcely make his way ten feet, the absence of life, except the devilish looking crabs, crawling around on the roots, the stillness, and often the vile odor of rotten oysters, all combine to make a mangrove swamp, though fascinating, a place to be left as soon as possible, and I always felt, on leaving as if I were being chased by all sorts of bacterial germs. In some places land is being reclaimed from the sea quite rapidly by these swamps. The trees live only in salt water and die off as soon as the land is dry. Thus the inner edge of a swamp is composed of dead or dying trunks or loop like roots, while the outer edge is constantly pushing out into the water as soil is gradually accumulated by the roots. This extension seaward is carried on first by means of the aerial roots which either spring from the arched roots, in which case they curve outward and downward, or from the branches, when they drop nearly vertically. These frequently branch and re-branch before reaching the mud in which they become fastened.

The second method is by means of the young plantlet, whose radicle elongates considerably before dropping from the tree, so that it is all ready to start out in life as soon as released. It is 8 or 10 inches long and cigar-shaped, thus placing the center of gravity near the lower end. In this condition it is carried in the water till the lower end strikes the mud, when roots are sent down, the leaves are developed and a young mangrove is started.

Along the seashore one sees an abundance of the seaside grape,[16] named from the likeness of the clusters of fruit to our cultivated Vitis and not from habit, for it is a straggling shrub or tree with large, round, smooth and unusually red-veined leaves.

Another common plant of the lowlands and one which the collector is likely to remember with regret is the necker-bean.[17] This is a more or less climbing shrub, having the stem, petioles and even the under side of the midribs armed with recurved prickles and bearing clusters of spiny pods which contain about two drab seeds of the size of marbles. The hand is easily introduced to gather the flowers, but the withdrawal is resisted by dozens of prickles—like a patent rat-trap.

In swampy places one usually finds the familiar Job's tears[18]

---

[16] **Cocoloba uvifera.** (Polygon.)
[17] **Guilandina Bonducella.** (Legum.)
[18] **Coix lachryma.** (Gram.)

with which baskets and other ornamental articles are made. At first sight one would hardly think that the hard bean-like seeds belonged to a grass.

In the forest we saw many trees whose names were familiar. Among them was the mahogany,[19] a majestic tree with globular woody fruit and abruptly pinnate leaves; and the logwood,[20] a small, leguminous tree, bearing at that season an abundance of flowers and fruit, and extensively naturalized in Jamaica. Large quantities of its wood and also of fustic[21] are exported for extracting the dye. As it is very bulky it would seem more economical to extract the dye on the island.

The trumpet tree,[22] rather common and quite conspicuous from its large leaves whitened beneath and clustered at the ends of the long branches, is quite useful on account of the fiber obtained from the inner bark. Out of this is made a very durable cordage; also whips by peeling back the bark, cutting off the inner wood except enough for a handle, and plaiting the fiber into a lash.

In the dense woods grows the cacoon,[23] a high-climbing leguminous vine bearing an immense pod as much as three or four feet long which contains the large sea-beans often washed up by the sea on sandy beaches.

Many woody climbers in their youth entwine various trees, but these in time are strangled to death and rot away leaving the ungrateful vines as huge spirals, capable of bearing their own weight, having destroyed the ladders by which they mounted to their success.

I now mention a few of the more important fruits. Of the Anonaceæ there are the sugar apple,[24] about the size of an orange and green, the one-seeded carpids composing it being easily separated from each other; the custard apple[25] of about the same size but with the surface smooth and light brown; the sour sap,[26] larger, ovoid with the green surface weak-prickly; and the cherimoya[27] (Jeremiah, as the natives pronounce it), about the size of the foregoing, but with the

---

[19] Swietenia Mahogoni (Meliac)
[20] Haematoxylon Campechianum (Legum.)
[21] Maclura tinctoria (Urtic)
[22] Cecropia peltata (Urtic)
[23] Entada scandens (Legum)
[24] Rollinia Sieberi.
[25] Anona reticulata
[26] Anona squamosa
[27] Anona Cherimolia.

surface smooth and faceted. This last is certainly the most delicious fruit I ever tasted. We saw it only on Blue Mountain. The sour sap is acid and at first seemed to have the flavor of kerosene, but we soon became accustomed to it and when beaten up with sugar it was quite a delicacy.

The papaw,[28] a smooth yellow fruit, of one to three or even ten pounds weight, containing the numerous shot-like seeds in the center, tastes not unlike muskmelon. The guava,[29] from which the delicious guava jelly is made, is about the size of a lime, and like the pomegranate, contains so many seeds that it is not desirable eating though pleasant flavored.

The naseberry,[30] or sapodilla as it is called in the Bahamas and to some extent in Kingston, is also about the size of a lime, but has a rough brown skin and one or two large black seeds.

The alligator pear[31] was a grievous disappointment. It is about the size of a goose egg and contains one large seed surrounded by yellow, and to us very insipid, flesh. It was learned that it should be flavored with salt, pepper, vinegar, savory, etc., when its insipidity would be overcome.

The mango,[32] in spite of its slight turpentine flavor, was very good eating, but it requires considerable experience to eat it without daubing the juice all over the face. The fruit is somewhat larger than the alligator pear and flattened. It contains a large seed, whose surface is covered with long fiber, out of which the pulp must be sucked.

Oranges, and sweet ones, too, are plenty. We bought them at fifty cents per hundred. Bananas are also abundant, but strange to say, we found great difficulty in getting ripe ones, as they are picked for shipment when green. They sell for twenty-five cents a bunch. Plantains[33] resemble bananas but can be distinguished by the longer neck to the fruit. They are eaten fried in cocoanut oil or butter, being while raw very inferior to bananas.

The akee[34] is a red, pear-shaped or slightly three-sided fruit, which contains a pulp (arillus) of the color and consist-

---

[28] Carica Papaya. (Papayac.)
[29] Psidium Guava. (Myrtac)
[30] Sapota achras (Sapotac)
[31] Persea gratissima. (Laurin.)
[32] Mangifera Indica. (Terebinth.)
[33] Musa paradisiaca. (Musac.)
[34] Blighia sapida. (Sapind.)

ency of beef-fat. At maturity it bursts open, exposing the large, glossy black seeds. It is used to flavor fish.

There are several starch-containing food plants which are little seen in the north. The yam[35] probably furnishes more food in Jamaica than any other plants grown. It seemed inferior to either the sweet potato or the Irish potato, being coarser and rather tasteless. The tuberous roots are large, irregular, and frequently weigh several pounds.

The cassava[36] (tapioca, mandioca) also furnishes a large amount of food to the poorer classes. The rhizomes are six or eight inches long and rather slender. The skin is peeled off, the flesh grated and mashed thoroughly with water. The residue is used to make cassava bread or cakes. The wash water is allowed to stand, when the suspended matter settles. This is used for starching clothes.

A third starch producing plant, quite common along the northern coast of Jamaica, is the coco.[37] This somewhat resembles a giant calla-lily. The rhizomes, or "coco-feet" are roasted and eaten quite commonly by the natives. The arrow-root[38] belonging to the canna family is also grown.

The bread-fruit[39] tree is cultivated, and has become naturalized in many places. The fruit, which looks like a big osage orange, is much relished by Jamaicans, but as was the case with many tropical fruits and vegetables, it seemed to us to lack flavor. Its near relative, the jack-tree[40] with much larger oblong fruit is less common.

The chocho[41] a prickly oblong vegetable resembling a cucumber, is prepared for eating in the same way as squash and tastes like it.

The ocara,[42] not uncommon in northern gardens; bayberry[43] whose leaves are often used for flavoring; allspice,[44] rose-apple,[45] a tree with leaves like the mango, but with large white flowers having numerous long stamens; tama-

---

[35] Dioscorea, alata. etc. (Diosc)
[36] Janipha Manihot (Euphorb.)
[37] Colocasia esculenta (Aroid)
[38] Maranta sp. (Scitam.)
[39] Artocarpus incisa. (Urticac)
[40] A integrifolia.
[41] Lechium edule. (Cucurb)
[42] Abelmoschus moschatus. (Malvac)
[43] Pimenta acris. (Myrtac.)
[44] Pimenta vulgaris.
[45] Jambosa vulgaris. (Myrtac.)

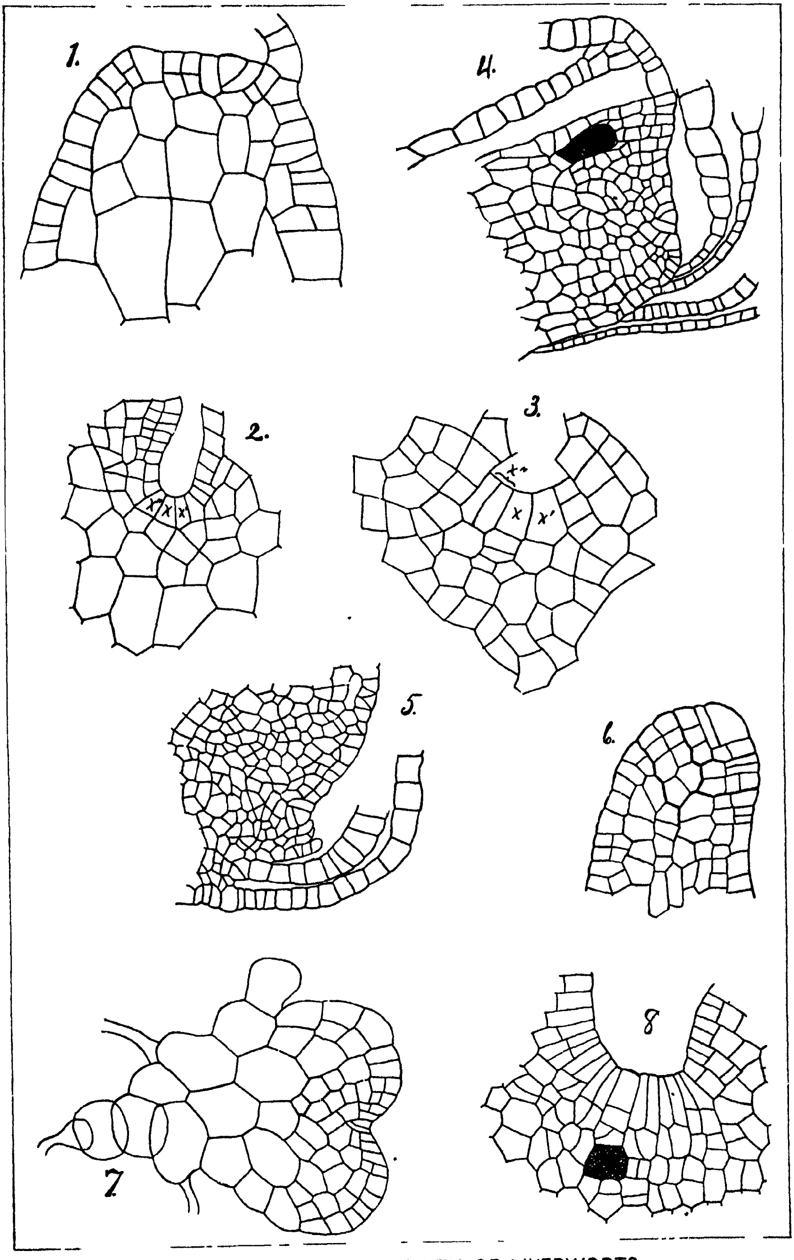
rind,[46] whose pods contain sweet but slightly acid pulp frequently put up as preserves; pigeon-pie;[47] calabash,[48] a tree with few wide-spreading, horizontal branches and fascicled, oblanceolate leaves, the fruit of which is made into drinking vessels, etc.; the cashew,[49] whose roots taste something like peanuts; the star-apple,[50] a beautiful tree with leaves glossy, dark-green above and ferruginous silky-pubescent beneath; the bimbling[51] bearing its exceedingly sour fruit directly from the trunk; the annatto[52] (spelled also annotto, arnotto, etc.,) with prickly pods, the contents of which yields to water the red coloring matter of commerce; all these are frequent in cultivation, and were to us among the most interesting features of the island

Two other plants deserve mention. One is the sorrel[53] which we observed only in the Lucca district, where it is common. It grows to the height of three or four feet, losing its leaves in the fall. The calyx continues to grow and becomes ripe about Christmas. It is then a brilliant scarlet and quite juicy, tasting like Oxalis. The juice is extracted with hot water, flavored with spices and sweetened, thus making a very refreshing drink.

The second plant is the coco or cacao,[54] from which chocolate is made. The peculiarity of this tree is that the small flowers grow in fascicles right out of the trunk. One sees flowers and all stages of fruit on the same tree. The latter when ripe is a dark red in color, ovoid, six or eight inches long, with ten longitudinal furrows. The seeds are washed free from pulp, carefully dried, and (when made by the natives on a small scale) pounded into coarse powder between stones. To this is added cocoanut oil and enough annatto to color it, when it is formed into cylinders about the size of a candle and six or eight inches long. The cocoanut oil is prepared by grating up the ripe nut, usually very laboriously by the use of an ordinary tin grater, boiling the meal with water and skimming the oil off. A little annatto is usually added to give it a yellow color.

---

[46] Tamarindus Indica (Legum)
[47] Cajanus Indicus (Legum)
[48] Crescentia Cujete Bignon)
[49] Anacardium occidentale (Terebinth.)
[50] Chrysophyllum Cainito (Sapot)
[51] Averrhoa Bilimbi (Oxalid)
[52] Bixa orellana (Bixin)
[53] Hibiscus Sabdarifa (Malvac)
[54] Theobroma cacao (Buettner.)



MOTTIER on APICAL GROWTH OF LIVERWORTS.

On our way home from Jamaica we stopped for three days at Grand Cayman. This is a small coral island midway between Jamaica and the west end of Cuba, and a dependency of the former. The inhabitants are mostly white, very hospitable, and differ from those of the other islands visited in being active, thrifty and enterprising. Here we saw the walnut,[55] whose fruit resembles our black walnut in taste, shape and in being enclosed in a rather woody shuck.

Another interesting tree which we did not see in Jamaica, was the manchioneal.[56] The inhabitants told great stories about its deadly effects and warned me against it. To test the matter I rubbed some of the fresh juice on the back of my hand, allowing it to remain three hours, without result. This only proves that the plant does not always have the effect ascribed to it. But it seems to be a fact, from the common report, that the juice will frequently form bad sores where it touches the skin. As is the case with our poison ivy, it probably depends upon circumstances and the individual.

During the trip I made collections of seeds, living plants and herbarium specimens which are being studied at the Garden. There are many difficulties in the way of collecting dried plants in the tropics. One of the worst is the humidity of the atmosphere. I succeeded in avoiding all trouble from mould by using drying paper (best quality carpet paper) which had been previously impregnated with corrosive sublimate. I used wire presses, with straps, changed the papers at least twice a day, and frequently exposed the already dried bundles to the sun.

Missouri Botanical Garden, St. Louis.

Notes on the apical growth of Liverworts.

DAVID M. MOTTIER.

(WITH PLATE XIII)

The striking similarity between the very young thallus of certain liverworts and fern prothallia is a familiar fact to botanists and has led me to suspect that a careful study of the apical growth of several available forms, by more accurate

[55] Aleurites triloba. (Euphorb.)
[56] Hippomane mancinella (Euphorb.)

methods than have been heretofore used, might perhaps throw more light upon the affinities of these groups of plants, or add something toward the confirmation of the generally accepted views.

As is well known, the commonly accepted view of botanists is that growth in the thallus in the Marchantiaceæ and allied forms takes place by means of several initial cells.[1] From careful serial microtome sections of young plants grown from gemmæ of *Marchantia polymorpha* it seems very probable that in these young plants there is only one apical cell. In a series of longitudinal vertical sections of a number of young plants only one apical cell was found (fig. 1). Sections made parallel to the surface (longitudinal transverse) of plants of the same size and age as those just mentioned show two or three cells lying side by side, which have been regarded as initial cells, and may yet be so regarded. Kny (Bau und Entwickelung von Marchantia polymorpha, p. 374) says: "At the bottom of the apical indentation, slightly bent toward the under side, there is a row of cells each of which is bounded externally by a free, slightly curved wall and has two side walls converging slightly toward the front and two posterior meeting the latter at right angles and cutting each other at the back (nach rückwärts). [That is, the apical cell is in the shape of a broad wedge]. Although one or two cells necessarily occupy a middle position within the row, we cannot therefore speak positively of two or more apical cells, because it is not possible to demonstrate that a certain one or two cells form the permanent organic middle point from which regular segments are derived. The possibility is not excluded that by further growth in width on one side of the apical region, one cell, at first exactly in the middle, or its axial descendants, may be pushed to one side." Now from sections parallel to the surface of a young plant of Marchantia polymorpha (fig. 2) it is difficult to say whether cells x, x', and x'', are all apical cells or just one, x. From the statement of Kny just quoted I am rather inclined to think that one cell, x, is the true apical cell, and x' and x'' are segments just cut off in the order indicated. From fig. 3, a similar section of the thallus of *Asterella hemisphærica*, it is seen that very much the same order exists, it being difficult, if not impossible, to decide whether one, x, is the apical cell and x' and

[1] Schenk: Handbuch, vol. 2, p. 331. 1882. Leitgeb: Untersuchungen ueber die Lebermoose, part 6, p. 2. 1879. Also: part 4, p. 16.

x'' only segments, or whether all are apical cells. Essentially the same thing occurs in *Conocephalus conicus*, *Anthoceros lævis*, and *Riccia*. Moreover as stated in a foregoing paragraph, only one apical cell has been found in longitudinal vertical sections, as shown in figures 1, 4, 5, and 6. Yet it may be, from the fact that this row of cells is arranged in a curved position on account of the hinder part being wider than the fore-edge, that longitudinal sections would pass only directly through the long axis of one cell, the others being cut more or less obliquely, thus obliterating the appearance of the segments of the apical cell. In older plants this might perhaps be more probable, but in young plants (and this was the kind used) the planes of the longitudinal axes do not seem to diverge enough to obscure the arrangement of the segments.

However this may be as to the number of apical cells, such are the facts observed by me, and from these it seems that it is as probable that there is but one as that there are several.

The resemblance between a fern prothallium and a young thallus of Marchantia polymorpha grown from a spore, is indeed very striking, as will be seen upon comparing fig. 7 with a young prothallium. In this (fig. 7) there is but one apical cell whose segments already cut off can be followed without the slightest difficulty. A transverse section through the growing region of a fern prothallium shows a structure similar to that in the liverworts under consideration (fig. 8). Here will be seen one or several initial cells, the number varying with the width of the sinus.

All sections were cut from specimens imbedded in paraffin, by a Minot microtome. The specimens were fixed in chromic acid 1 per cent. or absolute alcohol, stained *in toto* with alum cochineal, and counterstained on the slide with Bismarck brown (70 per cent. alcohol solution). The Bismarck brown is a very satisfactory stain for cell walls.

Indiana University, Bloomington, Ind., March 5, 1891.

EXPLANATION OF PLATE XIII — Fig. 1, longitudinal vertical section of growing point of young thallus of Marchantia polymorpha.— Fig 2, transverse longitudinal section of similar plant — Fig 3, transverse longitudinal section through growing point of Asterella hemisphærica.— Fig. 4, longitudinal vertical section of same plant as 3 — Fig. 5, same, of Conocephalus conicus — Fig. 6, same, of Anthoceros lævis — Fig 7, young thallus of Marchantia polymorpha grown from spore (after Kny). — Fig. 8, transverse longitudinal section through the apical region of a prothallium of Onoclea struthiopteris; the shaded cell is the egg-cell of an archegonium

All figures are magnified about 350 diam. except 6 which is about 175 diam. and 7 about 1200 diam

Some new Solanaceæ from Guatemala.

JOHN M. COULTER.

Mr. John Donnell Smith submitted to me a bundle of Solanaceous plants from his recent Gautemalan collections. Among them I find the following species which seem worthy of characterization, although in the present confused state of our knowledge concerning this perplexing group absolute certainty seems unattainable. Without any desire of possibly multiplying synonymy these species are put on record as follows:

Solanum Donnell-Smithii n. sp.—Said to be a vine, more or less rough with stellate hairs: prickles stout and subulate or recurved, yellowish, especially stout on the stem, usually more slender on the midrib and principal veins, copious or scanty: leaves rather large and membranaceous, oblong or ovate, sinuate-toothed or lobed, or even entire, 7 to 15 cm. long, with equally 4 to 6-rayed hairs below, and central division much elongated in the otherwise shorter-rayed hairs above: the simple loose few-flowered racemes or cymes soon lateral: calyx deeply 5-cleft, with stout often bulbous-dilated prickles and mostly long-acuminate lobes: corolla 2.5 cm. or more in diameter, whitish or light blue(?), deeply parted into lance-linear lobes, which are thickly stellate-pubescent without: anthers linear-lanceolate: the smooth globose berries becoming 1.5 to 2 cm. or more in diameter, turning red(?).—Escuintla, Depart. Escuintla, alt. 1100 ft., March 1890 (*J. D. S.* 2268); Concepcion, Depart. Escuintla, alt. 1200 ft., April 1890 (*J. D. S.* 2261); San Juan Mixtan, Depart. Escuintla, alt. 500 ft., April 1890 (*J. D. S.* 2262).

Brachistus Escuintlensis n. sp.—Glabrous throughout or minutely puberulent: leaves large and thin, ovate (often broadly so), acute or acuminate, usually oblique at base and more or less tapering into a petiole, entire or with a slightly wavy margin, very unequal in size, the largest becoming 20 to 23 cm. long and 12 to 13 cm. broad: flowers on pedicels of various lengths in umbellate axillary clusters along the main stem or on leafy branches: the short and broadly campanulate calyx with an entire margin (rarely a few almost indistinguishable teeth): corolla about 12 mm. long with 5 erect lobes 4 or 5 mm. long: berry globose, 8 to 9 mm. in diameter.—Escuintla, Depart. Escuintla, alt. 1100 ft., March 1890 (*J. D. S.* 2267).

Bassovia Donnell-Smithii n. sp.—Said to be 24 dm. high, more or less softly pubescent or even hirsute, the upper parts of the stem and inflorescence glandular: leaves ample and thin, petioled, ovate to ovate-lanceolate, acuminate, from almost entire to sharply sinuate-toothed or lobed, 7.5 to 17.5 cm. long, minutely pubescent above, more conspicuously pubescent below, the midrib and principal veins usually prominently bordered by dense whitish pubescence: flowers on long pedicels in rather dense axillary umbellate clusters: the glandular calyx with small but evident teeth: corolla with ovate obtuse or acute glandular lobes 5 or 6 mm. long: anthers whitish-scarious along the lines of dehiscence: "fruit red".—Gautemala, Depart. Guatemala, alt. 5000 ft., February 1890 (*J. D. S.* 2270); Dueñas, Depart. Zacatepequez, alt. 5000 ft., April 1890 (*J. D. S.* 2258).

BASSOVIA MACROPHYLLA. — Pansamalá, Depart. Alta Verapaz, alt. 3800 ft., April 1889 (*Türckheim* 1438). This plant was at first considered to be a variety of the new *B. Mexicana* B. L. Robinson, of Pringle's distribution of 1890, and is so reported in Mr. Smith's "Enumeration", Part II. However, Mr. Robinson has since kindly looked into the matter, and the conclusion seems evident that it is the South American Witheringia macrophylla, a plant of puzzling synonymy. Bentham and Hooker refer it to *Bassovia*, and Miers to *Brachistus*. The disposition made of it by Bentham and Hooker seems to be the most natural one.

Crawfordsville, Ind.

New Grasses.

GEORGE VASEY.

The discovery of a second species of Orcuttia makes it necessary to somewhat modify the generic characters. They should now read as follows:

[Tribe FESTUCEÆ, sub-tribe *Sesleriecæ.*] **Orcuttia.**— Panicle somewhat spicate, with short, simple, alternate, sessile spikelets, somewhat distant below, and crowded toward the summit: spikelets many flowered, compressed: empty and flowering glumes much alike, with many prominent straight nerves, strongly toothed or lobed at the apex: palet equaling

its glume, narrow, thin, green on the strongly angled keels: anthers 3, styles 2, filaments and styles projecting beyond the apex.

Orcuttia Greenei n. sp.—Apparently annual, culms cespitose, many from one root, erect, finely pubescent, 8 to 10 inches high, with 8 or 10 nodes: sheaths shorter than internodes, loose, the lower ones particularly so, pubescent and striate: leaves erect, rigid, narrow, 1 to 1½ inches long, pungently pointed, the upper sheathing the base of the panicle: panicle 2 to 3 inches long, somewhat flattened, of 10 to 15 contiguous spikelets: spikelets flattish, ¼ to ½ inch long, of 5 to 15 flowers; empty glumes two-thirds as long as the flowering ones, all sparsely pubescent, green, oblong, with strongly toothed apex; flowering glumes 2 to 2¼ lines long, with about 5 sharp teeth at apex, folded excentrically; palet as long as its glume, narrow, strongly 2-keeled and hispid on the keels.—Collected on moist plains of the upper Sacramento, near Chico, California, June, 1890, by *Prof. E. L. Greene.*

Eragrostis spicata n. sp.—Culms perennial from strong rhizomes, erect, rigid, 3 to 4 feet high: leaves distant, rigid, erect, 10 to 15 inches long, involute toward the apex, sheaths longer than the internodes, ligule inconspicuous: panicle spike-like, very narrow, cylindrical, densely flowered, 10 to 15 inches long, tapering at top, branches closely appressed: spikelets about 3-flowered, 1 line long; empty glumes half as long, the upper broader, both obtuse or truncate, short ciliate on the keel; flowering glumes 3-nerved, short-falcate.—Collected at San Jose del Cabo, Lower California, by *T. S. Brandegee*, 1890.

Muhlenbergia Alamosæ n. sp.—Perennial, tufted: culms numerous, compressed or angled, erect, 2 to 2½ feet high, wiry, rarely with 1 or 2 branches near the base, with about 6 nodes, the upper ones distant: lower cauline leaves erect, short, 2 to 3 inches long, the uppermost 8 to 10 inches long, equalling the panicle: panicle 4 to 5 inches long, 1 to 2 inches wide, open, the branches in threes or fives below, unequal, capillary, the lower third or half naked, the upper part 15 to 20-flowered, pedicels short, diverging: spikelets purple, over 1 line long; empty glumes ovate-acuminate or awl-pointed, half as long as the flowering glume, which is white barbed below on the margins and on the nerves of the palet; awns flex-

uose, 6 to 8 lines long.—Collected at Alamosa in Sonora by *Dr. Ed. Palmer*, 1890, no. 407.

Calamagrostis densus n. sp.—Culms in large patches, from strong rootstocks, 3 to 4 ft. high, robust, leafy, 5 to 6 nodes; the lower sheaths loose and longer than the internodes, the middle ones shorter than the internodes, the upper including the base of the panicle; leaves often a foot long, rigid, plane or becoming somewhat involute at the long slender points, somewhat scabrous, as are the sheaths; ligule 1 line long, lacerate: panicle strict, lance-oblong, 4 to 6 inches long, rachis slightly scabrous, branches somewhat verticilate, appressed, 1 inch long and densely flowered: spikelets crowded, 2 to 2½ lines long; outer glumes linear-lanceolate, nearly equal, acute, slightly scabrous, margins slightly scarious; third (or flowering) glume a little shorter, narrow, apex slightly toothed and mucronate, a few short hairs at the base; awn, twisted near the base, a little longer than its glume; palet a little shorter than the glume, thin; sterile tuft, slender, one-third to one-half as long as the glumes, with few hairs.—Collected near Julian, San Diego co., California, by *C. R. Orcutt.*

Calamagrostis kœlerioides n. sp.—Culms erect, 2 feet high, rather rigid, smooth: leaves 2 to 6 inches long, narrow, somewhat scabrous, ligule conspicuous, laciniate, blade rigid, pointed, the upper very short: panicle spike-like, narrow, 3 to 4 inches long, the branches in short, approximate (or at the base rather distant) clusters: spikelets about 2 lines long, linear-lanceolate, rather smaller, but otherwise much as in *Calamagrostis densus;* the panicle having much the appearance of *Kœleria cristata.*—Collected near Julian, San Diego co., California, by *C. R. Orcutt.*

Department of Agriculture, Washington, D. C.

BRIEFER ARTICLES.

Simple mechanism to show geotropism.—Take the works of an old clock run by a weight rather than a spring and support them horizontally, i. e. with the shafts vertical. The weight is to be carried over a pulley outside the works and the pendulum is to be removed so that the wheels may be made to revolve at a much more rapid rate than in the clock. One of the shafts, that bearing the scape wheel, is longer

than the rest, so that the scape wheel is outside the frame, i. e. above it in the position described, being supported by a bearing not in the frame itself, but in a separate piece bent and riveted to the frame. This piece must be cut away and a new bearing made for the shaft under the scape wheel instead of above, which any ingenious boy can easily do. This leaves the scape wheel free to carry the seed pans.

Solder the middle of a stout, horizontal brass wire six inches long to the face of the scape wheel, and to each end of this wire a deep tin pill-box, an inch and a half in diameter, one for a seed pan and the other to be filled with ballast for a counterpoise. The edge of the pill-box, not its face, should be towards the wheel, and the face of it should be inclined at an angle of about sixty degrees to the horizon so that the radicles of the germinating seeds in their downward growth may press against the advancing face of the box. Most of this face should be cut away and a piece of glass put inside to serve as a window. Against this put the seeds, already germinated so that their radicles begin to appear, placing the radicles so as to point downward; fill the box with moist saw-dust, and set it going in a warm place, using a heavy driving weight (I used about twelve pounds). This will make the brass arms carrying the pill-boxes revolve at a sufficient rate to create considerable centrifugal force in the boxes. The germinating radicles will feel the force of this enough to deflect them at a considerable angle from the perpendicular.

The apparatus will run several hours and if you do not want to sit up nights to wind it, all the better, as the direction of growth during the night will be so obviously different from that during the day when the apparatus is running as to make the experiment more conclusive. —GOODWIN D. SWEZEY, *Crete, Nebraska.*

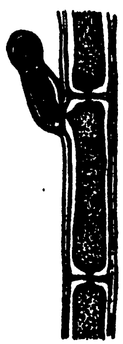
Notes from Columbus, Ohio.—Among my last summer's collections from this vicinity was a form of *Bidens connata* Muhl. which was typical in every respect except that it had upwardly barbed awns. Dr. Sereno Watson, to whom the specimen was submitted, pronounced it unchanged in other characters. In making a revision of Sullivant's catalogue of plants of this vicinity, I find mention of plants near *B. frondosa* L., "except smaller and smoother; heads fewer-flowered, with pappus upwardly scabrous."

The following species of western plants, with the exception of Dysodia (not heretofore known in this locality), were collected the last of October about the winter-quarters of Sells Brothers' Circus, at Sellsville, Ohio, near Columbus, the Croton alone being out of bloom: Erodium cicutarium, Aster pauciflorus, Amphiachyris dracunculoides, Dysodia chrysanthemoides, Gutierrezia Texana, Helenium nudi-

florum, H. tenuifolium, Parthenium Hysterophorus, Solanum rostratum, Monarda citriodora, and Croton capitatum. The plants were first noticed by W. J. Greene of the Ohio Experiment Station, and appeared to be growing well and spreading. The seed was evidently scattered from cars or wagons upon the return of the show at the close of the season.—AUG. D. SELBY, *Columbus, Ohio.*

Continuity of the protoplasm in the Chantransia form of Batrachospermum.—Strasburger (Botanisches Practicum, p. 403, 2nd German edition), mentions the fact of the continuity of the protoplasm between the cells of filaments of Batrachospermum. The writer's attention was attracted to this phenomenon while studying the Chantransia form of one of the species of Batrachospermum, probably Chantransia (Batrachospermum) macrospora, from Florida; and the protoplasmic connection was so evident that he thought the readers of the BOTANICAL GAZETTE might be interested in his observations.

The phenomenon was first noticed in a slide of the alga which had been mounted in glycerine jelly. In preparing the specimen for the jelly the glycerine had caused a slight shrinkage of the cell-contents, drawing it away from the cell-walls in all parts of the cells except at the ends, where fine threads of protoplasm which pierced the end walls were plainly seen to connect the shrunken masses of protoplasm in the different cells. The figure, showing this condition, was drawn from a filament on this slide with a Abbé camera, power 600 diameters, (reduced one-half).



A very sasisfactory way of demonstrating the presence of the connecting fibril is to stain the alga filaments with an alcoholic solution of eosin, wash in water, and then carefully shrink the contents of the cells with dilute glycerine: The water washes the eosin out of the cell-walls leaving the granular matter of the cells deeply stained and the connecting protoplasmic threads slightly colored. Borax carmine also gave satisfactory results. Iodine and methyl violet did not differentiate clearly enough, the cell-walls being so deeply stained as to obscure the protoplasmic connections. However, the green filaments, with the contents shrunken a little, exhibit the connecting fibril in an unmistakable way. The Chantransia form is better to demonstrate the continuity of the protoplasm than the sexual form, because the cells are as a whole much larger.—BRADLEY M. DAVIS, *Indiana University, Bloomington.*

A method of studying the growth of tubers.—After a careful examination of all the literature on tubers and tubercles at hand it appears

that the application of the Baranetzky auxanometer to a study of their growth is either unknown or rarely practiced. No record of such use can be found. The writer therefore ventures to note a method of setting up the apparatus, for this purpose, which is now being employed with good results in the botanical laboratories of the University of Minnesota.

Potatoes are selected that make the tubers habitually some distance from the base of the aerial stem. The soil is removed through a separable side of the culture-box and a tuber is exposed. This is blocked up rigidly from below, in such a manner that no downward movement of the tuber can take place. A jacket made of two small square pieces of cigar-box wood is now fitted on the upper and under sides of the tuber, the lower piece resting on the block below. The pieces are held around the tuber by means of very slender rubber-bands and by small cleats on their faces which grip the tuber gently. The upper of these squares of wood is furnished with a central screw to which the thread of the tracing wheel is attached. The whole is then covered with soil and the side of the box replaced. The smoked cylinder is now brought into position, the battery and clock connected and the tracing-needle adjusted. The clock should be set to release the armature every three hours. Now, when growth takes place in the tuber, since no movement downward can ensue, the thread is released and the tracing-needle makes a vertical stroke, indicating the growth. (See Vines : Physiology p. 399; Sachs : Physiol. Eng. trans. p. 557; Pfeffer : Pflanzenphysiologie II, p. 86; Detmer : Handbuch Pflanzenphys. p. 257; Goodale : Physiol. Bot. p. 383.)

Experiments made up to date indicate but do not demonstrate a daily periodicity in the growth of the potato tuber. If such is the case two explanations would at once suggest themselves. Since the apparent maximum of growth in this organ lies between 10 P. M. and 8 A. M. it might be compared with aerial shoots and the rhythm be considered a hereditary trait, as the embryonic positive-heliotropic curvature of ivy shoots. More reasonable, however, would be the other explanation, co-ordinating the daily rhythm of the tuber with the rhythmic production of starch in the assimilating surfaces.

A more extended series of experiments along this line is being conducted by Mr. C. P. Lommen and he will doubtless be able to speak more fully upon the matter later on. This note merely calls attention to the method of study.—CONWAY MACMILLAN, *University of Minnesota.*

A monstrous form of a common field daisy.—The plant which I am about to describe was received from Virginia where it was found

blooming in a fence corner in December last during a period of warm sunny days and occasional sharp, frosty nights.

The head is normal as to the involucre, the white rays and a zone of a certain width of disk flowers. Then however comes a zone of ray flowers again, standing more or less upright and looking outwards; and surmounting the rounded summit of the receptacle is a tuft of the brown bordered scales quite similar except as to size to those of the involucre. There is no extension of the normal axis and no tendency to a repetition of the flowering or vegetating shoot; hence it is not an example of the not uncommon *proliferation* unless we shou'd call it a case of inverted proliferation which would not be accounting for its existence.

The explanation which I would offer is based upon a hint obtained from Sachs's Plant Physiology where he describes an abnormal sunflower in illustrating the principles of acropetal succession in growth. I should say that an injury, possibly cold, arrested growth at the developing apex of the receptacle when this latter was still quite young so that it ceased to be the growing point. Just below and round about this region renewed proliferation of embryonic tissue began and proceeded backwards towards the older parts, forming a new growing zone to which the arrested original growing point now stood in the same relation as the older parts in the ordinary receptacle stand to the normal growing apex or centrum. In further development the disposition of the members of the inflorescence would now be in the true but inverted progressive sequence from the older to the newer parts of the axis; that is, the abnormally placed involucral scales about the center, followed by the ring of ray flowers and these succeeded by the disk flowers which merge into those of the unaltered parts of the receptacle.—B. W. BARTON, *Baltimore, Md.*

EDITORIAL.

IT REALLY SEEMS that the flood gates have been opened in the matter of priority in nomenclature and that we are to be deluged with ancient names for well-known plants. That too great conservatism may have withheld the authors of our floras from making needful changes may be conceded to those who are radical reformers, since it is of no importance for our present purpose. But the search after new-old names is leading those who are making changes into some ludicrous and even ridiculous blunders. It is not our intention to

single out examples of these from the numerous ones in recent publications. Rather it is our endeavor to stay the tide of folly.

MANY BOTANISTS who appreciate their limitations in the matter of describing new species, ignore or underrate their limitations in the matter of nomenclature. It is vastly easier as a rule to determine and describe a new species than to settle on the oldest proper name of a plant. In the latter, experience is of even greater value than in the former. Those who think it a mere matter of searching through books will find in their undoing that it is much more.

IS IT not also curious, from a psychological point of view, that one who is compiling a local flora or writing an article on local plants, should decline to use the names applied to the plants in the flora of the country — names which it is quite certain designate unmistakably what plant is meant — and should go searching after other names which *may* be older and *may* be applicable to the plants under consideration? Is it not evident that something other than a clear indication of the plants is sought? Is it the cheap renown of differing from "an authority?"

WHILE LESQUEREUX and James's Manual is the best book on the mosses of North America, let us use the names therein, even though we see their faults. While Gray's Manual remains the best book on the flowering plants of its range let us use its names, and "therewith be content." And so of every book. Accept the best till there is a better. Only when monographing a group has one a moral right to discard any name however bad.

CURRENT LITERATURE.

Minor Notices.

PLANTÆ EUROPEÆ is the title of an important work by Dr. K. Richter, whose first volume has just appeared. It is intended to be a systematic enumeration, with synonymy, of the indigenous phanerogams of Europe. The first volume contains 378 pages, with a very complete index, and presents the Gymnosperms and Monocotyledons. In the matter of nomenclature the oldest specific name is adopted, in whatever genus it has appeared. The Gymnosperms show 8 genera and 40 species; while the Monocotyledons have an enumeration of 251 genera and 1799 species. The largest family is Gramineæ, with 751 species, followed by Liliaceæ (342 species), Cyperaceæ (287 species), Orchidaceæ (170 species), and Iridaceæ (105 species). The work is an

exceedingly important one, not only in bringing together in handy form all the species of phanerogams with their synonymy, but also in helping establish the nomenclature of European plants. It is published by Wilhelm Engelmann of Leipzig.

A HANDBOOK of Geographical Botany, by Dr. Oscar Drude, has recently been issued from the press of J. Engelhorn of Stuttgart, as one of a series of geographical handbooks under the general direction of Dr. F. Ratzel. The book contains nearly 600 pages and several colored maps, and is altogether one of the most complete compends of phytogeography that has appeared. The relation of plants to environment is discussed in all its ramifications. The conditions which cause a special display of certain plant groups in different regions are fully considered; and finally the different plant regions of the earth (some twenty-one principal ones) are described. We would commend this book to any would-be translator, as one that deserves to be speedily translated into English, for its range is world-wide and its usefulness should be equally extensive.

AN INTERESTING WORK, by A. Osw. Kihlman, entitled "Pflanzenbiologische Studien aus Russisch Lappland," has just been published in Helsingfors (Finland). It appears as a part of the Proceedings of the Finnish Biological Society. The book contains 300 pages, many additional tables, 14 plates, and a colored map. The plates, which are reproduced from photographs, are exceedingly interesting, showing the landscape of Lapland and the characteristic plant life. The flat land, the scraggy shrubs and trees, the deep snows, and the altogether dreary look make a strong impression. Of course, all this is but superficial; and the effect of these conditions on plant life is the theme which is fully discussed.

OPEN LETTERS.

To phytographers, especially Cryptogamists.

La longue expérience que j'ai faite dans l'élaboration de mon *Sylloge Fungorum omnium* m' a persuadé de l'utilité, je dirai même de la nécessité, de suivre dans la description des plantes certaines règles qui sont trop souvent négligées. Voici ces recommendations:

1. Il est nécessaire que les botanistes qui décrivent des espèces nouvelles en les traitant du point de vue de la morphologie et de la biologie, avec des détails très minutieux et très compliqués, y joignent des diagnoses spécifiques ou génériques (préférablement en latin) concises et comparatives selon les règles phytographiques. En effet il est très difficile et souvent très ambigu de choisir dans la foule des détails les caractères essentiels et différentiels.

2. La phrase spécifique ou diagnose est, pour certains auteurs particulièrement cryptogamistes, excessivement détaillée et prolixe et trop laconique pour d'autres. Une bonne phrase spécifique doit donner, en forme assez concise et claire, seulement les caractères essentiels et différentiels. Toute observation de détail doit être reléquée après la diagnose. Il est encore nécessaire pour les espèces nouvelles d'indiquer son affinité avec les autres connues plus prochaines. Celui qui détermine des espèces nouvelles sait combien de temps il doit perdre pour la détermination s' il a à faire avec des diagnoses très prolixes et sans notions d' affinité.

3. L'expèrience a déjà démontré, du moins dans la cryptogamie, qu'il est très utile, pour la désignation de la patérnité d'une espèce, d'indiquer entre parenthèses l'auteur qui a le premier décrit sous d'autres genres cette espèce. Il est toujours nécessaire d'ajouter le nom de l'auteur qui a transporté l'espèce du genre primitif à un autre, car sans cela on devrait entendre que l'auteur de l'ouvrage où la combinaison des noms est citée, est également l'auteur de cette combinaison. Nous trouvons par ex. dans les écrits de Winter des noms semblables: "*Sphærella convexula* (Schwein.) Syn. *Sphæria convexula* Schwein." Si nous n'ajoutons pas le nom Thümen après la parenthèse nous devrions croire que Winter est l'auteur de la combinaison; et alors nous aurons d'après les règles d'autres botanistes les deux notations suivantes: *Sphærella convexula* (Schwein.) Wint. ou *Sphærella convexula* Wint. qui sont toutes les deux fausses. Mais si nous disons *Sphærella convexula* (Schwein.) Thüm. nous avons la notion très exacte que Schweinitz a créé l'espèce et que Thümen l'a rapportée à son juste genre.

4. En décrivant les cryptogames parasites, il faut citer les plantes ou les animaux nourriciers avec la nomenclature technique latine. Les noms vulgaires (anglais, italiens, etc.) sont souvent difficiles à être identifiés.

5. Pour les mesures des organes tant microscopiques que macroscopiques, il est nécessaire d'adopter une mesure unique, savoir celle métrique; pour les mesures microscopiques, laissant de côté toute fraction, on devra préférer les micromillimètres ou microns (*micra*, μ). Les différentes mesures et les fractionnaires sont très souvent cause d' erreur ou de doute.

6. Pour désigner briévement les dimensions des organes microscopiques il convient (comme du reste plusieurs le font) d'indiquer d' abord le chiffre de la longueur et ensuite celui de la largeur plus grande avec le signe $\underset{\smile}{\smile}$ entre l'une et l'autre en se passant du signe μ; si l' organe est comprimé on pourra ajouter encore le chiffre de l'épaisseur, par ex. : spore $15 \underset{\smile}{\smile} 4$ signifie spore longue 15 μ et large et épaisse 4 μ; spore $15 \underset{\smile}{\smile} 4 \underset{\smile}{\smile} 2$ signifie spore longue 15 μ, large 4 μ et épaisse 2 μ. Plusieurs auteurs au lieu du signe $\underset{\smile}{\smile}$ (que j 'ai proposé et suivi depuis 1872) emploient les signes $=$, $:$, $\times$, qui pour les mathématiciens ont une signification différente et définie. Pour les organes macroscopiques on devra indiquer la qualité de la mesure, savoir m., cm., mm. et la partie mesurée.

7. Dans la désignation de tous les groupes des plantes en général on emploie des noms féminins (*Dicotyledones*, *Ranunculaceæ*, *Anemoneæ*, etc.; on devra faire de même pour les Cryptogames; ainsi si nous

disons *Sphæriaceæ*, *Mucedineæ*, *Hydneæ*, etc., nous devrons necessairement dire aussi: *Pyrenomyceteæ*, *Hyphomyceteæ*, *Hymenomyceteæ* et non *Pyrenomycetes*, *Hyphomycetes*, *Hymenomycetes* comme voudraient beaucoup d' auteurs.

8. Les couleurs des plantes et particulièrement celles des corolles, des Champignons, des spores etc., sont souvent décrites avec des noms de signification incertaine. Il serait bien d' employer une nomenclature défine appuyée à des échantillons normales. Je vais publier à cet effet une *chromotaxie* qui sera, je l' espére, de grande utilité.

9. Pour ce qui concerne la nomenclature des fruits et des spores des Champignons, il serait utile d'employer seulement la suivante, qui au reste est adoptèe par la plupart des mycologues:

Hymenomyceteæ: Pileus (quelle forme qu'il soit) ; basidia; sterigmata; sporæ; cystidia.

Gasteromyceteæ et *Myxomyceteae*: Peridium; gleba; capillitium; flocci; sporæ.

Uredineae: Sorus; uredosporae; teleutosporæ; mesosporae; pseudoperidium; æcidiosporæ; paraphyses.

Ustilagineae: Sorus; sporæ.

Phycomyceteae: Oogonia; oosporæ; antheridia; spermatia; zygosporæ; azygosporæ; zoosporangia; zoosporæ.

Pyrenomyceteae et *Phymatosphaeriaceae:* Stroma; perithecium; loculi; ascus; sporidia; paraphyses.

Discomyceteae et *Tuberoideae*: Ascoma; gleba; ascus; sporidia; paraphyses.

Schizomyceteae: Filamenta; baculi; cocci; endosporæ; arthrosporæ.

Sphaeropsidae: Perithecium; basidia; sporulæ.

Melanconieae: Acervulus; basidia; conidia (et non *gonidia*, nom qui doit être reservé aux Lichens).

Hyphomyceteae: Caespitulus; sporodochium; hyphae; sporae.

OBS.: Si la spore germe, il se forme le promycelium qui généralement produit les sporidiola.—P. A. SACCARDO, *Padua, Italy.*

NOTES AND NEWS.

PROF. MAXIMOWICZ, of St. Petersburg, well known to all students of systematic botany, died February 16.

M. MARCEL BRANDZA is publishing in *Revue générale de Botanique*, an exhaustive paper on the development of the seed coats.

IN *Le Botaniste* (Feb. 25) M. P. A. Dangeard has a valuable illustrated paper on the morphology and anatomy of *Tmesipteris*.

THE REPORT of the mycologist, Dr. Roland Thaxter, to the Connecticut experiment station for the year 1890, is devoted to an extended account of the deep scab of potatoes and the organism that produces it, notes on several other plant diseases, and an excellent account fo certain fungicides and methods for their application.

UNDER THE EDITORSHIP of Prof. L. H. Bailey, the *American Garden* has become the sprightliest and most readable of the journals of its class.

THE FIRST BULLETIN of the Agricultural Experiment Station of North Dakota deals with grain smuts, a contribution by the Botanist, Mr. H. L. Bolley.

IN THE first of the Beihefte zum Botanisches Centralblatt F. Ludwig gives a résumé of the papers appearing during 1890 on the relation between plants and snails.

PROFESSOR JOHN M. COULTER has been elected President of the State University of Indiana, and will enter upon his duties at Bloomington next September.

IN *Journal of Botany* (March), Mr. T. D. A. Cockerell gives some account of the conspicuous European weeds that have become naturalized in the United States.

A POPULAR volume by M. C. Cooke, on the subject of edible fungi, will be issued shortly. It will be of a moderate size and price, and will contain colored plates of forty-four edible species.

M. A. LOTHELIER has shown by experiments that plants like Berberis or Hawthorn produce spines more freely in direct proportion to the degree in which they are exposed to the light.—*Gard. Chron.*

DR. EDWARD PALMER has recently returned from a three months collecting trip at Manzanilla and Colima, Mexico, having obtained about 500 species. These species will be reported upon by the botanists of the Department of Agriculture.

IN AN account in the *Botaniska Notiser* of European Uredineæ occurring at Quito, J. G. Lagerheim describes a new parasite of Puccinia graminis, which he calls *Fusarium Uredinis.* It attacks the uredosori, giving them a pinkish color.

IN *American Garden* (March), Mr. Walter Deane gives an interesting and illustrated account of the native orchids of New England. Every species seems to be mentioned and in a very readable way by one who knows them well in their native haunts.

FOUR SPECIES of North American plants have become established in the vicinity of Pavia, Italy, according to M. Bozzi (Atti. Soc. Ital. Sc. Nat., xxxi, p. 281). They are Oxybaphus nyctagineus, Commelina Virginica, Elodea Canadensis and Azolla Caroliniana.

THE SUMMER COURSE in botany at Harvard University will begin at the Botanic Gardens June 29, and continue five weeks. It will be under the instruction of Mr. W. F. Ganong, Instructor in Botany, and Mr. G. F. Pierce, Assistant in Botany, in Harvard University.

DR. DOUGLAS H. CAMPBELL has been appointed Associate Professor of Botany at the new Stanford University of California. As the Pacific slope is already well supplied with workers in systematic botany, that subject will not be represented at present in the new University.

A SORGHUM smut (*Ustilago Reiliana* Kühn) new to the United States is recorded by Messrs. Kellerman and Swingle (Trans. Kans. Acad. Sci., xii, 158), as occuring in Kansas. It attacks the panicle, and reduces it to a more or less uniform mass of spores. In Europe it also attacks the staminal inflorescence of Indian corn.

DR. W. J. BEAL has issued a bulletin (no. 72) describing the six worst weeds of Michigan. They prove to be Cnicus arvensis, Lithospermum arvense, Verbascum Blattaria, Linaria vulgaris, Plantago lanceolata, and Rumex crispus. A sample of the seeds of each is glued upon one of the pages, so that the farmer may intelligently examine his seed before sowing.

IN HIS "Notes on North American Trees," Professor C. S. Sargent has taken up the genus Acer (*Garden and Forest*, April 1). In regard to the confused synonymy of our sugar maple, the author inclines to the use of Michaux's name *A. barbatum*. Following most late authors, he merges Negundo into Acer and uses the Linnæan *Acer Negundo* as the name of our box elder.

WE NOTE with pleasure that Mr. Thomas Meehan, the editor of the *Gardeners' Monthly* until its discontinuance at the death of the publisher, and so long and widely known by his botanical writings, will soon begin the publication, assisted by his sons, of a new journal of gardening and botanical miscellany. It will be known as *Meehan's Monthly*, and the first number will appear July 1.

THE BOTANICAL CLUB of Washington has begun to make arrangements for entertaining the botanists of the A. A. A. S. They are intending among other things to issue a souvenir of about 40 pages, giving some account of the trees and shrubs of the streets and parks, with photographic illustrations. The large number of botanists in Washington will no doubt do all in their power to make a week's stay pleasant for visiting botanists.

MR. GEO. B. SUDWORTH shows in *Garden and Forest* (April 8) that if botanists adhere to the priority of specific name as rigidly as zoologists, that three of our well known plants should be called Negundo Negundo, Sassafras Sassafras, and Catalpa Catalpa. It occurs to us that his point is well taken. These extraordinary combinations seem not to have given zoologists any trouble, as a list of names from Jordan's "Manual of Vertebrates" testifies.

NEARLY ONE-TENTH of the British *Agaricini*, the group of mushrooms and toadstools, are good eating, as we learn from *Grevillea* (xix, 83). There are 1,400 species in the British Isles, of which somewhat over half are too small, rare or tough to be of culinary value. This leaves 680 species that may be edible. Of this number 134 are known to be suitable for the table, some 30 are poisonous, and of the remaining 516, nothing certain is known.

THE POPULAR notion that the sunflowers turn with the sun has been put to the test by W. A. Kellerman, who records (Trans. Kans. Acad. Sci., xii, 140), a large number of observations on the wild Helianthus annuus. He finds that about 87 per cent. of the heads while in bloom

show movement during the day, and a less percentage at night, but they usually turn through only a few degrees of arc. During the day 23 per cent. move somewhat toward the west, and 8 per cent. in the opposite direction. At night 21 per cent. move eastward, and 8 per cent. westward.

ANOTHER considerable contribution has been given by Mr. F. Boergesen in his "Desmidieæ" [1] to the knowledge of this group of Algae from Brazil. The material had been collected by Glaziou in St. Paul, and the number of about 130 species and varieties includes about 50 new ones, illustrated in four plates, finely prepared by the author himself. Of species and varieties enumerated, the largest numbers belong to the genera Cosmarium (29), Staurastrum (24), Closterium and Euastrum (16), Micrasterias (10), etc. The diagnoses are all given in Latin.—T. H.

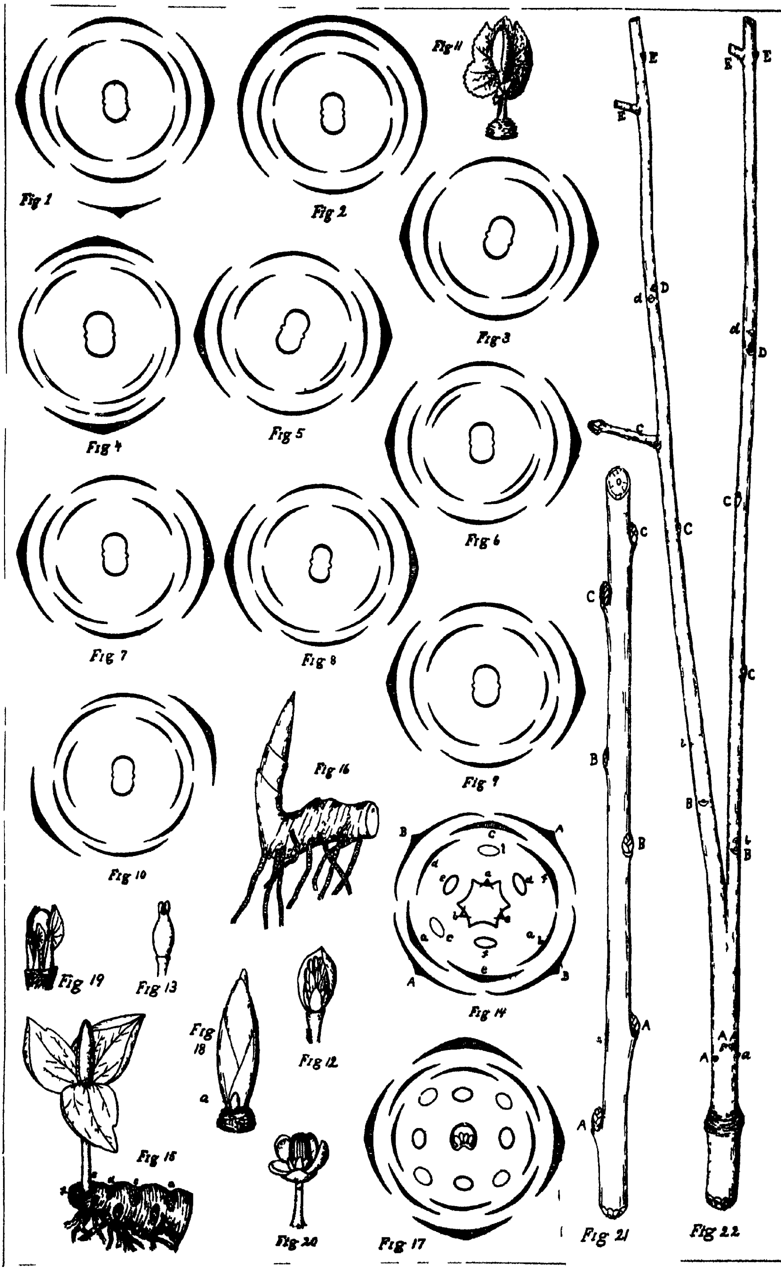
WE are glad to welcome the first annual Bulletin of the Swiss Botanical Society. It is a volume of nearly 170 pages, with 3 plates, and contains original papers by Dr. H. Christ, Prof. Dr. Cramer, Dr. J. Früh, and Dr. H. Schinz. In addition to this there is an account of communications made to the society, among which we note a revision of *Krameriaceæ* in which *K. lanceolata* Torr. is made var. *angustifolia* of *K. secundiflora* DC. A good feature is an excellent and full résumé of the botanical work done during 1890 which had any reference to the Swiss flora.

THE PRODUCTION of tubercles on the roots of English beans has been accomplished by M. W. Beyerinck (Bot. Zeit., xlviii, 837) by growing the beans in a sterilized soil and applying pure liquid cultures of bacteria. The apparatus employed is of new and ingenious design. The experiments so far completed show that the tubercles on the various leguminous plants are not due to a single species of bacteria, but to several, which are also distinct from the soil bacteria producing nitrification. They also establish the fact that the bacterial growths do not originate within the plants, for the roots remained free of tubercles so long as the cultures of the specific bacteria were not introduced.

AN EARLY collapse of the plan of publishing general Fungi Exsiccati is predicted by M. C. Cooke in the last number of *Grevillea*, on the ground that there are too many being issued with too much duplication, both in the same and in different series. He notes that Puccinia graminis appears under six numbers in one series, and also under six numbers in another series, and both sets by the same collector. Pleospora herbarum appears under eleven numbers in one series, and under eighteen in another. A long list of American species is given, each species of which has been issued in from one to three American series and in as many foreign ones also. He advocates the publication of series restricted to certain groups. These views must meet the approval of the majority of mycologists.

---

[1] Eug. Warming, Symbolae ad floram Brasiliae Centr. cognosc. Particula XXXIV. Saertryk af Vidensk. Meddel. fra Naturhist. Forening, 1890. Copenhagen.



FOERSTE on PHYLLOTAXY

VOL. XVI. NO. 6.—BOTANICAL GAZETTE.—JUNE, 1891.

Abnormal phyllotactic conditions as shown by the leaves or flowers of certain plants.

AUG. F. FOERSTE.

(WITH PLATE XIV)

Sanguinaria Canadensis.—Baillon interpreted the flowers of the blood-root so as to make the petals form two decussating dimerous whorls, which by dedoublement have become whorls of four petals each. The petals of the inner whorl should therefore be directly superposed to those of the outer whorl, and the two sepals should occupy a position intermediate between two petals of the outer whorl in each case. Eichler, in his important work "Blüthendiagramme," copies this view. Unfortunately this interpretation is incorrect, as may be seen at any locality where the blood-root is at all common. For the purpose of the following notes many hundreds of flowers were examined, and the accompanying diagrams illustrate all the cases found.

It is not a rare occurrence in some, perhaps isolated, localities to find a single scale about half way up the flower peduncle, subtending a second flower. In this case the sepals of the subtended flower seem to occupy a position transverse to that of the scale. The outer set of four petals is interpreted as consisting of two dimerous whorls, the lower pair of petals decussating with the sepals, and the other pair of petals taking a position directly above the sepals. The inner set of four petals alternates with the outer set taken as a whole, and may be interpreted either as a dimerous whorl decussating with the second pair of petals, and numbering four in consequence of dedoublement, or as a whorl of four petals, showing the usual arrangement of whorls consisting of four members preceding or following dimerous whorls. The latter interpretation is shown to be the correct one by such cases as are represented by fig. 3, in which the inner whorl of petals is reduced to three, but the odd petal never occupies a median position above one of the outer petals, as it should if it represented the undivided petal of a dimerous whorl. The pistil consists of two leaves, which typically decussate with

the sepals, so that the position of the sepals can be determined even when they have fallen off, which they do as soon as the flower opens. This typical arrangement of the flowers is illustrated in fig. 1. The stamens have been omitted from this diagram because nothing definite could be determined regarding their arrangement. However, the fact that the leaves forming the pistil decussate with the sepals suggested the following interpretation. The stamens are too numerous to be interpreted as a single whorl, even if dedoublement be allowed its play, especially when it is considered that *Canbya*, showing the smallest number of stamens known, six, possesses at least two whorls of stamens, and that most species demand a greater number. The blood-root must have more than two whorls in order to make the pistil leaves decussate in regular succession with the previous whorl, and with the sepals. Three whorls at least are therefore represented by the stamens, but for the present all question of dedoublement must be left undecided.

During the examination of a great number of flowers belonging to the same species it was to be expected that anomalous forms would be found Most of these were isolated cases, such as a single sepal, evidently formed by the junction of the two ordinary sepals, fig. 2; or the more important case of sepals occupying a position directly beneath the pistil leaves, fig. 4, in which case it is necessary to assume an even instead of an odd number of staminal whorls in order to explain away their abnormal position, or rather the abnormal position of the pistil leaves. Slightly diagonal positions of the sepals are occasionally met with, but the extreme cases, such as that illustrated in fig. 10, are almost always more apparent than real, and rest upon the fact that the attachment of the sepals at their base takes up about half of the circumference of the peduncle at this point. As this base, however, represents the linear area from which the development of the sepals proceeded, a slight extension of this area to the right or the left often serves to place the indefinite median line of the sepals in a position more or less oblique to the remaining members of the flower. These exceptional conditions are mentioned only for the sake of completeness.

A far more interesting group of variations from the typical arrangement first described is that shown by the petals, and when the great frequency of such variations from the type is

considered, the fact that they can all be reduced to a few series is extremely interesting. It is especially to be noted that the abnormal conditions immediately to be cited, regarding the arrangement of the petals, have no subsequent effect upon the position of the pistil leaves, and therefore can not consist in the interpolation of new whorls of petals, but must arise from dedoublement and the new conditions which dedoublement in preceding whorls often forces upon those which immediately succeed. The most common case consists in the addition of one, figs. 4 and 5, or two petals, fig. 6, to the inner whorl of petals, in such a manner that they take a diagonal position in the flower diagram, more or less approaching the transverse position which a dimerous whorl should take if it were added to the whorls already existing. That these petals are not to be interpreted in this way, but as formed by dedoublement in the nearest petals, is suggested by the unchanged position of the pistil leaves, as already mentioned. A second case consists in the removal of one, fig. 7, or two petals, fig. 8, belonging to the inner whorl of four petals, to the middle dimerous whorl, thus giving the second whorl of petals three or four members instead of two. Since this removal takes place in a direction away from a transverse line connecting the sepals the result is to leave the original petals in nearly their normal position, and to bring the added petals into a median position. That this second whorl does not consist typically of four petals in these cases is shown by the fact that the space opposite the intercalated petals is left vacant, whereas a whorl of four members should be equally distributed. According as one or two petals have been removed from the inner whorl to the middle whorl, one or two petals are added to those remaining in the inner whorl and these added petals are again placed near a transverse line connecting the sepals, but on the same side of this line.

In a third case, one, fig. 9, or both petals of the second dimerous whorl have become two by dedoublement. In that case the four petals of the inner whorl occupy as nearly as may be their original positions and one, fig. 9, or two petals are added to their number and then occupy the interval created by the separation of petals of the second whorl into two through dedoublement. In this case the addition is made precisely in line with the transverse position occupied by the sepals. The three variations from the type just described are

all frequent enough to be considered characteristic of this plant. The first variation is the most common, the second, next, the third, least frequent.

A unique case is illustrated in fig. 10. Here the oblique position of the sepals is not considered of moment owing to the normal position shown by the first set of petals; it is illustrated, however, because it is the only *good* case of oblique position of sepals found during these investigations. The second set of petals consists of four members. It would be easy to say that dedoublement had taken place but then in that case two of the petals of the inner whorl should not take up a position so decidedly transverse to that shown by the first whorl of petals. Again the interpretation of the inner whorl as a dimerous whorl is excluded by the third petal which seems to make an effort to continue the greater number of members usually shown by this whorl. If this case were not unique, it would spoil all value of the previous observations.

As it is, a number of interesting facts seem to have been brought to light, not usually considered in the study of phyllotactic arrangements shown by flowers. The first of these is that new members are not added indifferently to those already existing, but follow certain laws or tendencies. The most general of these, in the blood-root, is that added members have a tendency toward placing themselves in a position more or less in line with the sepals, obliquely so in the first set of variations described, on one side of this line in the second set, and exactly in line in the third set. These positions are more or less approximately that which a new dimerous whorl would take if added to those already existing. A second fact is that succeeding whorls attempt to accommodate themselves to abnormal conditions shown by previous whorls. This finds its best expression in the intercalation of new petals in succeeding whorls in order to fill up the interval caused, apparently by dedoublement, in the preceding whorl. A third fact is that these changes in the arrangement of the petals as here instanced have taken place without producing any effect upon the position of the leaves of the pistil, and hence have not the value of newly added whorls. It is difficult to decide how far dedoublement can account for these phenomena, where its application has been quoted, or even omitted.

The slightly oblique position shown occasionally by the pistil leaves, is due largely to crowding during their later development in the bud.

The buds should be studied at as early a stage as possible. Fig. 11 represents a plant, as it was seen on Feb. 15th, during a very cold winter. The protecting scales have been removed and the larger leaf forcibly expanded. Fig. 12 shows the petals and stamens, partly enclosed by one sepal, the other having been cut away. Fig. 13 gives a slightly magnified view of the pistil at this period. It is evident from the size already attained by the organs, that flower buds should be studied for phyllotactic purposes during the summer previous to their flowering season.

Trillium sessile.—In the spring of 1882 a four leaved Trillium was found which illustrated admirably the attempt of succeeding whorls to continue or accommodate themselves to the abnormal conditions presented by previous whorls. This case is illustrated by fig. 14; the letters serve to designate the flower members but have no other significance. In the normal development of this plant there should be three sepals and three petals, in decussating whorls. The outer set of floral envelopes, marked *a*, *b*, *c*, should have been sepals, and the inner set, marked *d*, *e*, *f*, should have been petals. Instead of that, sepal *e* occupies the position of a petal, and together with sepal *c* attempts to attach itself to the whorl of four leaves as though it were an independent dimerous whorl of sepals. This attempt, however, is spoiled by sepal *a* in its usual position, but as if to maintain at least the semblance of a dimerous whorl, that part of petal *f* which lies next to sepal *c* is colored greenish like a sepal, and thus *c* and half of *f* are opposed to *a* and *e*. Further *b*, which should be a sepal, is developed as a petal, and only two of the first whorl of stamens are in existence, *b* and *c*, the third *a* being entirely absent. The second whorl of stamens and the leaves present the normal conditions. If now this case be considered as the attempt of a trimerous plant to accommodate itself to the dimerous conditions presented by the leaves, then the absence of a stamen in the first whorl can be explained. The dimerous whorl of leaves *A*, *A*, is succeeded in decussating order by a second similar whorl *B*, *B*; and this in a similar way by *a*, *e* and *c* with the adjacent part of *f*, all acting together as a simple dimerous whorl, decussating with *B*, *B*, and all having a greenish color. With this in turn the purple petals *d* and *b* are found decussating, occupying a position almost directly in line with the leaves, *B*, *B*. The trimerous character of the plant

retains sufficient power to keep half of *f* deep purple as a petal should be. Decussating with *d* and *b* are the stamens *b* and *c* as a dimerous whorl. The stamen *a* which is absent, would be out of place in a dimerous whorl. The typical trimerous character is first again fully developed in the second set of stamens and is retained by the pistil leaves.

The appearance of this plant in early winter is shown by fig. 16. The seedling always starts to grow near the surface of the ground, and pushes its way laterally under the soil. Fresh roots start each year from the anterior growths of the stem, the older roots decay, and when with age the anterior roots begin to wrinkle and hence to contract, they have a tendency to pull the growing end of the Trillium deeper and deeper into the soil. In a similar way the roots of *Symplocarpus fœtidus* and *Arisæma triphyllum* draw the stems or corms of these plants deeper and deeper into the soil, but in the latter cases directly downwards. Fig. 15 shows the leaves and flower bud of fig. 16, with the protecting scales removed. At the base of the flowering stem *e* is seen a bud *f*, which represents the flowering stem of the season following *e*. The rootstock has been wrenched so as to show better the fact that the flowering stems and hence their scars *d*, *c*, *a*, and others are placed alternately on the right and on the left side of the rootstock.

Jeffersonia diphylla.—Gray has given a diagram for the flowers of the twin-leaf which makes them tetramerous, with the exception of the pistil which has only one leaf. (Genera Fl. Amer. Bor. Ill., vol. i, 34). In southwestern Ohio, where this plant is very abundant, the calyx almost always has five members, arranged rather on the plan of a spiral than that of a whorl. Four sepals were a comparatively rare exception. Two whorls of petals and two whorls of stamens were tetramerous in either case, whether the sepals were four or five in number. Typical Berberidaceæ possess an equal number of members in each of the whorls of the sepals, petals, and stamens. Perhaps it was the attempt to correlate the diagram of Jeffersonia with those of typical Berberidaceæ which led to the selection of the less frequent forms with a tetramerous calyx, as representing the typical Jeffersonia. The rarity of tetramerous forms in the calyx, and the frequency of flowers with five sepals however, makes it plausible that the five sepaled calyx still points to the original pentamerous spiral

character of these whorls, which at present is no longer shown by the petals and stamens. In fig. 17, the figure given by Gray is repeated with certain variations, in order to call attention to the peculiar position of the single pistil-leaf. This leaf should fall opposite one of the stamens of the outer whorl. As a matter of fact, however, it is opposed to a stamen belonging to the inner whorl in the flowers examined.

Fig. 18 represents a subterranean bud of the twin-leaf, collected Feb. 15th with a few scales removed in order to show, at *a*, the bud from which is to develop the flowering bud two years hence. Fig. 19 shows the same bud after the removal of all the scales, in order to show the flower bud of the next season, surrounded by the leaves of the same season. Fig. 20 presents a view of this flower bud after the petals have been forcibly spread apart, showing the petals and stamens.

Rhamnus lanceolatus.—The branches of many shrubs near Dayton, Ohio, showed the leaf arrangement indicated in fig. 21, which may be briefly characterized as consisting of decussating dimerous whorls of leaves, in which the leaves, apparently belonging to the same node, are not strictly opposite to each other, but are separated by a more or less pronounced interval. This interval is in most cases not large enough to altogether destroy the effect of decussating whorls as just described. The same plants often show a typical two-fifths phyllotaxy. As a rule species of Rhamnus are described as possessing an alternate arrangement of leaves.

Fraxinus.—A twig collected at Granville, Ohio, is represented by fig. 22, but only one-fourth of its natural size. Here a branch has divided dichotomously, between the nodes *A* and *B*, but that the dichotomous character was already developed at a much earlier period is shown by the development of four leaves at the node *A*; the median two leaves should have met at the centre of the compound stem at this locality, but they have been crowded towards the exterior so that both appear in the figure here presented. That the dichotomous character was developed at an even earlier stage is shown by the position of the upper scales of the winter bud. The effect of this irregularity (best seen at *A*, upon the succeeding nodes *B*, and *C*,) is to increase the interval between the leaves belonging to the same node, already shown at *A*. This interval again diminishes at the node *D*, and ceases at node *E* in one branch and at node *F* (not figured) in the

other. The lateral branches are all normal. This case is quite typical for phenomena as shown by dichotomously branching abnormal stems with opposite leaves. The small letters indicate that the leaves are situated on the side of the branch away from the observer, and these leaves are indicated by dotted contours in the figures.

Heidelberg, Germany.

A study of some anatomical characters of North American Gramineæ. I.

THEO. HOLM.

The genus Uniola.

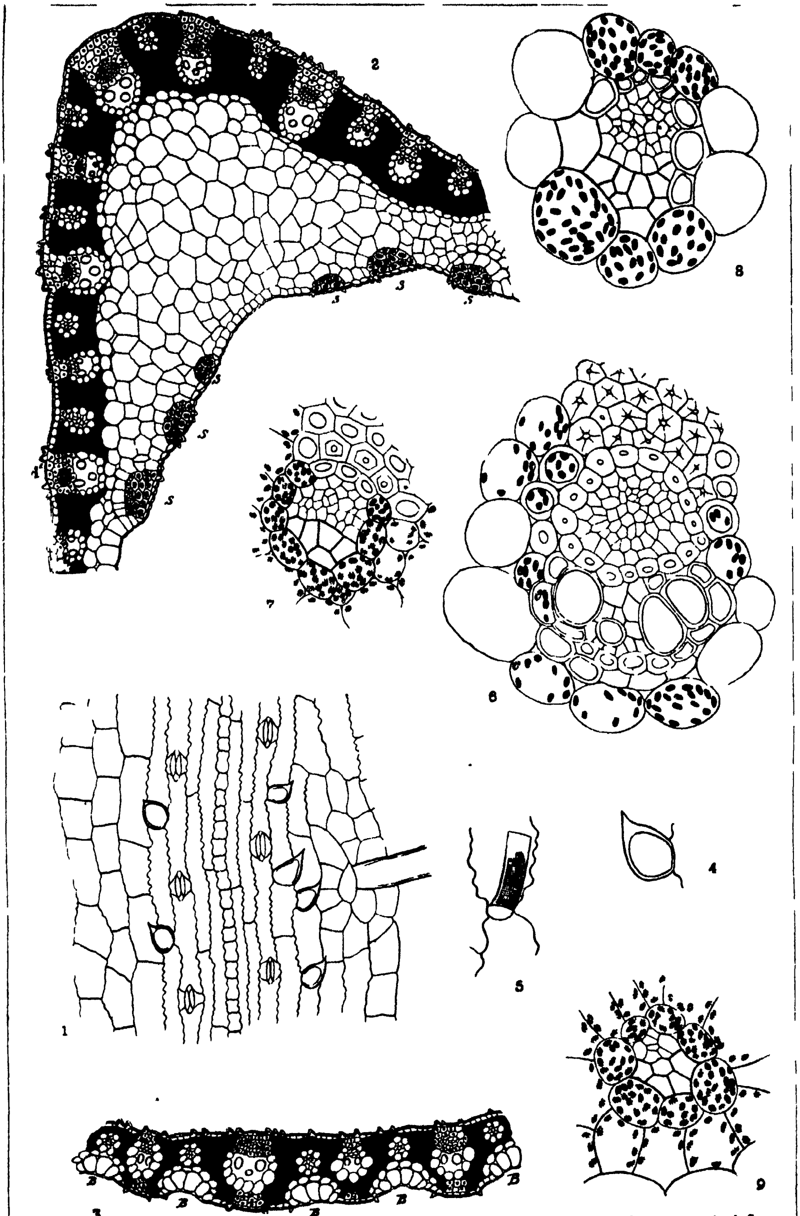
(WITH PLATE XV)

In the year 1810, when Brisseau-Mirbel said:[1] "Le seul moyen de perfectionner les familles naturelles, est à joindre à l'étude des caractères botaniques, celle de tous les faits relatifs à l'anatomie et à la physiologie," he hardly thought of the important change that would come about in systematic botany. The rapid increase in the number of species known made it evident that botanists must not content themselves with the mere external characters, but that others should be sought. Later appeared a series of researches especially by French and German authors, wherein an attempt was made to give anatomical diagnoses to a number of species; most successfully by Duval-Jouve, Radlkofer and Vesque. The importance of studies of that kind was very clear; they not only furnished additional and often even more reliable systematic characters, but they extended the study of anatomy into wider fields than ever before, until anatomy has become one of the most important modern lines of botanical science.

And the study of internal structure gave also a most striking illustration of the physiological life; it became easy to infer from the structure the conditions under which the plant had lived, whether in dry or moist localities, exposed to the sun or in deep shade, etc. Anatomy also rendered great help in the discrimination of species, as shown for instance by

---

[1] Sur l'anatomie et la physiologie des plantes de la famille des Labiées. (Ann. du Muséum d'Hist Nat. vol. xv)



Author ad nat del

HOLM on UNIOLA

Vesque,[2] who proved that the anatomical characters are much more distinct and precise than the organographical ones, and that species of *Capparideæ* may be easily distinguished merely by the structure of the leaves.

To speak in particular of the *Gramineæ*, we have several works of the greatest importance upon this subject. Duval-Jouve described[3] species of Agropyrum merely by the structure of the rhizomes, culms and leaves, and he stated in his "Histotaxie des feuilles de Graminées"[4] the principal modes of arrangement of the tissues in the leaves of this family in relation to the surrounding medium.

Furthermore Hackel in his "Monographia Festucarum Europæarum" (1882), has shown the importance of the leaf-structure as to the specific differences in Festuca. The same author has also observed that most of the species of the Andropogoneæ[5] show very good anatomical characters; and finally Güntz[6] has made a special study of the leaf-structure.

These studies are, however, not only of a purely scientific, but also of a practical value, and it is easy to understand, that they must be a great help, when it is necessary to identify specimens without flowers. But that this may be done it will be necessary to know the structure of a large number of species. That such determination is possible to a certain extent will be evident if we simply recall the numerous differences in the form of the rhizomes, the sheath ligule and blade of the leaves, the vernation, etc., which, combined with anatomical characters, seem likely to give very reliable results. A few attempts have already been made in the most practical manner to identify Grasses at a stage where the flowers are not developed, for instance by Samsoe Lund[7] and Beal.[8]

We now proceed to give some anatomical sketches of our native grasses, making the beginning with the genus *Uniola*, of which five species are enumerated from this country, namely:

---

[2] Essai d'une monographie anatomique et descriptive de la tribu des Capparées (Ann d. Sc Nat. Botanique, ser. 6, vol. xiii, 1882).

[3] Étude anatomique de quelques Graminées, et en particulier des Agropyrum de l'Hérault. (Mém d l'Acad. d Montpellier, vol. vii, 1870)

[4] Ann. d. Sc Nat. Botanique, ser 6, vol. i 1875

[5] A. et C. De Candolle Monographia Phanerog. Prodromi; vol vi, 1889.

[6] H. E M. Guentz: Untersuchungen ueber die anatomische Structur der Gramineenblaetter, etc. Inaug.-Dissert Leipzig, 1886.

[7] Vejledning til at kjende Græsser i blomsterlös Tilstand. Kjöbenhavn, 1882.

[8] W. J. Beal: Grasses of North America for farmers and students, 1887.

U. latifolia Michx., *U. gracilis* Michx., *U. nitida* Baldw., *U. paniculata* L. and *U. Palmeri* Vasey.

Uniola latifolia Michx.—A series of anatomical sections have been figured on plate xv. These sections have been taken from the middle part of a completely developed leaf.

As regards the structure of the epidermis of the superior face (fig. 1), this does not show anything of particular interest. The cells of which it consists are of different size and shape, forming longitudinal lines in the blade, and the differences depend upon situation.

The large bulliform cells[9] lie in broad lines, covering the green parenchyma between the large nerves, and they form about six rows of rectangular, uncolored cells. Sometimes and especially toward the midrib they are interrupted by prominent and roundish groups of cells, surrounding the base of long, stiff and pointed unicellular hairs. Bordering on each side of these strips of bulliform cells there are some rows of smaller, rectangular cells, the side-walls of which are more or less undulated. They cover a small part of the green parenchyma. The stomata are to be observed here, and they form only a single line on each side of the groups of bulliform cells, while the other lines possess numerous short, very thick-walled and pointed expansions. In alternation with these thorn-shaped expansions are also to be seen short, unicellular, slightly curved and obtuse hairs. Besides these rows of epidermis cells there are still a few, from one to five, rows which cover the stereome. These consist of very short and narrow cells, the walls of which are strongly thickened.

Comparing the epidermis of the superior face, described above, with that of the inferior face, we see the following differences. The bulliform cells are entirely absent, as well as the long hairs; the short hairs are on the contrary also to be observed here together with the thorn-shaped expansions, which are still more numerous on this face. The stomata show the same distribution and number as mentioned before.

We now examine a transverse section of the whole blade, which, compared with similar sections of the other species of the genus, shows differences worthy to be considered as specific. Figs. 2 and 3 represent respectively sections from the middle part of the blade and a small lateral part, adjoining this. The median nerve (fig. 2) does not occupy the whole

[9] Duval-Jouve; Histotaxie des feuilles de Graminées l. c. p. 316.

carene, but merely forms a centre for the entire system of the mestome. It is the strongest one, containing the farthest developed leptome and hadrome, and is supported by the largest group of stereome, but does not, however, connect the superior face of the blade with the inferior. The carene itself consists of two groups of mestome-bundles, one on each side of the median line, and these are all separated from the superior epidermis by an immense tissue of uncolored parenchyma. The uncolored parenchyma preponderates then in this part of the blade and is partly separated from the superior epidermis by six relatively strong bundles of stereome. In the lateral parts of the blade it is restricted to a single stratum inside the rows of bulliform cells.

As to the mestome bundles, there are in this species about seventy on each side of the median nerve, and they represent three different degrees of development. The largest (fig. 6) are characterized by having a layer of very thick-walled parenchyma between the leptome and the hadrome, completely enclosing the first, and both the leptome and hadrome are here strongly developed; furthermore by being supported by two large groups of stereome, above and below, just excepting the bundles of the carene, where no stereome is in connection with the superior face of the mestome. The second degree of development (fig. 8) shows smaller bundles of stereome above and below, and the leptome is not separated from the hadrome by any layer of thick-walled parenchyma; there is merely a semicircular layer of thick-walled parenchyma bordering on the leptome side. Fig. 9 illustrates one of the smallest mestome bundles, completely imbedded in the mesophyll and without any groups of stereome; there is no thick-walled parenchyma to be observed here within the proper parenchyma sheath.

As regards now the arrangement of these three different forms of mestome bundles, this is as follows: The two larger are constantly situated on each side of the groups of bulliform cells, while the smallest, those of third degree, are restricted to a position just between the bulliform cells and the inferior face of the blade. It must be remarked, however, that this arrangement does not include the bundles of the carene, for the reasons mentioned above. As to the number of these three forms, the smallest ones are the most numerous in the whole blade. It may be expressed diagramatically as follows:

$A^* - C - B - C - A - C - B - C - A^1 - C^1 - B^1 - C^2 - B^2 - C^3 - A^2$, where A indicates the largest bundles of mestome, the median being A*; B shows those of second and C those of third degree. A^1 corresponds then to the strong bundle in fig. 2, marked in the same manner, and it is situated below the outermost group of stereome in the figure, separated from this by the uncolored parenchyma. C^1 is the first bundle situated between the first group of bulliform cells and the inferior epidermis. The disposition of the groups of bulliform cells may be seen in the same formula, namely, between A^1 and B^1, B^1 and B^2, B^2 and A^2, just above the C's, beginning at C^1. This formula may not be strictly constant, but it gives, however, the general features concerning the relative number and arrangement of the mestome bundles.

Besides the proper parenchyma sheath of green or sometimes uncolored cells, never wanting in the mestome-bundles of the Gramineæ, some of these bundles show the presence of another sheath or at least a layer of thick-walled parenchyma inside this. A distinct thick-walled sheath is shown in fig. 6, enclosing the leptome, and we are able to trace it also in the small bundles (fig. 8), though not in the smallest ones (fig. 9). Schwendener[10] has called attention to the presence of this parenchyma, which in several instances looks very much like what the same author has called a "mestome-sheath." But in Uniola latifolia there is no mestome-sheath; for the reaction with concentrated sulphuric acid proved that the thick-walled cells, whether they form a closed sheath or not, merely belong to the mestome parenchyma. Furthermore, if it had been a mestome-sheath it would also have been present in the smallest bundles. The proper parenchyma sheath showed in some instances (fig. 7), a thickening of the cell-walls, especially in the cells which border on the leptome side.

Now, concerning the arrangement of the stereome-bundles, we have already seen in the description of the mestome that the arrangement is nearly identical. There is one group above and below the two largest mestome-bundles, but none at the smallest ones, and there are merely six isolated groups on the superior face of the carene, which are not in contact with the mestome. Besides there is also one rather strong group in each of the outermost parts of the blade, the margins.

---

[10] S. Schwendener; Die Mestomscheiden der Gramineenblaetter. (Sitzungsberichte d. wiss. Acad. Berlin, 1890).

The mesophyll in this species forms in a transverse section an interrupted line, being in immediate contact with the epidermis of the inferior face, except where it is interrupted by the large mestome-bundle of first or second degree. . It is on the contrary almost entirely separated from the superior epidermis by the stereome and the uncolored parenchyma under the bulliform cells. The mesophyll showed a rather firm structure without any lacunes.

These are the general features of the anatomical structure of the leaf of Uniola latifolia, and it will be shown in a following paper that these characters as compared with the corresponding ones in the other species are of truly specific rank.

U. S. National Museum, Washington, D. C.

EXPLANATION OF PLATE XV — *Sections of the leaf of Uniola latifolia* Fig. 1. Epidermis of the superior face, ×240 Fig 2. Transverse section through the middle part of the blade, the carene The black part of the figure represents the mesophyll, which borders on the large uncolored tissue of parenchyma The mestome bundles with their parenchyma sheaths and groups of stereome are to be seen in the mesophyll Six rather large bundles of stereome (*S*) are to be seen on the superior face, the concave part of the carene. ×75. Fig. 3. Transverse section through a part of the blade, next to that figured in fig. 2. Five groups of the large bulliform cells are to be seen at *B* ×75. Fig 4. Thorn-shaped expansion from the superior face, ×320. Fig 5 Hair from the inferior face, ×320. Fig 6 Transverse section of one of the largest mestome bundles of the carene, showing the partly green parenchyma sheath, the leptome above and the hadrome below The leptome is surrounded by a sheath of very thick-walled mestome-parenchyma bordering on a group of stereome. ×560. Fig 7. Transverse section of a small mestome bundle, that next to the midrib Three cells of the green parenchyma sheath show a distinct thickening of the cell wall A group of stereome borders on the leptome side ×560. Fig. 8 Transverse section of a small mestome bundle from one of the lateral parts of the blade There is a horseshoe-shaped sheath of thick-walled parenchyma on the leptome side, and the proper parenchyma sheath shows four uncolored cells, while the other ones contain chlorophyll ×560. Fig. 9 Transverse section of a small mestome bundle, not far from that figured in fig. 8. The parenchyma sheath is perfectly green, and there is no thick-walled parenchyma inside this ×560.

On the organization of the fossil plants of the Coal-measures.[1]

DAVID WHITE.

[The following review contains so much of anatomical importance that we give it this more conspicuous place.—EDS.]

The observations recorded in these three memoirs, while confined chiefly to types, most of which have been treated more or less in the preceding parts, are hardly less remarkable for the information they bring to bear on the mode of the formation of the medulla and the development of exogenous growth in certain Carboniferous cryptogams, than for the proof they furnish of the existence of an exogenous growth among the Carboniferous ferns.

Part XV throws new light on the structure of the rhizomes and petioles belonging to Corda's genera Zygopteris and Anachoropteris, as recognized by Renault, Stenzel, and others, which Williamson shows to be generically equivalent. For these he prefers the name *Rachiopteris* proposed by himself in 1874 (Pt. VI, p. 677) "for a considerable number of these objects which appeared to be either rhizomes or petioles of ferns," for the reason that an examination of the structure of living ferns, classified by their fructification, shows that "no classification of fossil ferns based solely on the characters revealed in transverse sections of their petiolar bundles can be of value." Neither Prof. Williamson nor several other recent authors, seems to be aware of the coincident fact that Dawson in 1861 (Q. J. G. S. L., xviii, p. 323), with equal appropriateness, proposed the new genus *Rhachiopteris* "to include such Devonian stipes as indicate the existence of distinct species of ferns, of which the fronds have perished." Schimper does not seem to have known of Dawson's genus when he established his *Rhacopteris* (Traité, I, 1869, p. 481), based on the character of the fronds. Incognizance of these facts and the too common mis-spelling of the generic names have caused much confusion in the nomenclature.

To a fine species, from the Halifax deposits, related to Renault's *Anachoropteris Decaisnii*, Williamson gives the

[1] WILLIAMSON, W. C —On the organization of the fossil plants of the Coal-measures. Phil. Trans. Roy Soc. London. Part XV, vol. 180 (1889) B. pp. 155–168, pl. i–iv. Part xvi, l. c , pp. 195–214, pl. v–viii. Part xvii, op. cit., vol. 181 (1890) B. pp. 89–106, pl. xii–xv

name *Rachiopteris Grayii*, while the section of a hairy branching stem or rhizome, also from Halifax, resembling in many respects the young branches of living Marsileæ, is named *R. hirsuta*. Two roots, from Halifax and Oldham, showing tructure minutely, are called *Rhizonium verticillatum* and *R. reticulatum;* and a third, equally remarkable in structure, whose features resemble those seen in the cortex of *Asterophyllites Williamsonis*, is named *R. lacunosum.* The examination of new specimens of *Calamostachys Binneyana* has enabled the author to fill two gaps in the knowledge of the structure of that interesting form of strobilus, viz. the distribution of the vascular bundles of the central axis, and the peripheral termination of the sporangiophores. Sections of a fertile strobilus through the latter show a thickened distal end, occupied by clusters of tracheids concentrated in the region where each sporangium is organically attached, showing "that these peripheral terminations of the sporangiophores approach even nearer than they were previously known to do to those of the living Equisetum, in corresponding parts of which similar clusters of tracheids exist."

Part XVI is devoted to studies of the mode of branching, the formation of the medulla, and the method of exogenous growth as seen in a number of Lepidodendra, several of which are here first described. The author considers the ordinary mode of branching in this genus to have been dichotomous, with a perfect dichotomy of the medullary vascular cylinder, but that only a segment was cut off from that vascular bundle when the branch was of a special kind, "characterized by an arrested development," such as is represented by the tubercles of *Halonia*, or the scars of *Ulodendron* in which the arrested branches supported Lepidostrobi, both of the latter genera being only "conditions" of various Lepidodendroid genera.

He finds that the germs for the gradual formation of a medulla in the center of a vascular bundle which previously contained no traces of cellular structure were furnished by the procambium from which, in the youngest twigs, the entire bundle originated. The first one or two medullary cells, formed in the centre of the bundle of tracheids, increased by the ordinary meristemic process of enlargement and fission. The internal tension produced by the enlargement of the med-

ullary cellular expansion caused the vessels of the vascular bundle to form a ring increasing in size, the number of vessels also increasing correspondingly and changing their respective positions. This meristemic process is repeated "until the medulla and its surrounding vascular ring attain to their ultimate magnitude—a condition which was probably coincident with the first appearance of the more external exogenous zone." It is probable that the new vessels are produced centrifugally, on the cortical side of the vascular cylinder, though it is possible that some of the young medullary cells assumed a procambial form and were converted into vessels. In any case he considers that the enlargement of the medullary vascular cylinder is mainly, if not wholly, effected "through the internal tension occasioned by the subsequent multiplications and expansions of the medullary cells—a condition that has no existence among the exogenously-grown trees now living." He regards the occurrence of an exogenous growth at some time in the development of all the Carboniferous Lepidodendra as more than probable.

The existence of an exogenous growth among the arborescent Lycopods, Gymnosperms, and Calamarias has long been known. Part XVII of these memoirs has the important office of making known the existence of an exogenous development among the Carboniferous ferns. The anticipation expressed by the author, in Part IV, that *Dictyoxylon* (*Lyginodendron*) *Oldhamium*, there described as belonging to the paleozoic Proto-gymnosperms, might be identical with the petioles described in the same memoir as *Edraxylon*, and later (Part VI) as *Rachiopteris aspera*, is now confirmed, and the two are conclusively proved to be trunk and petiole of the same plant. The study is thorough; the steps in the growth of the petiole from the trunk are observed with the accuracy and minuteness of detail characteristic of the author's former memoirs. The pairs of vascular bundles so characteristic and conspicuous in the middle cortex of *L. Oldhamium* are shown to pass outwards through the outward cortex and become the tracheal bundles of the petioles of *R. aspera*. The clusters of tracheæ, in the small stems, which at first formed one united axial cluster, are separated, the space thus produced at the center being occupied by a steadily expanding parenchymatous medulla. This process is accompanied by a corresponding enormous increase in the number of the vascu-

lar laminæ, the inner extremities of which, though commencing their growth at different periods of life, all start from the medullary border of the vascular zone and extend to the periphery. Among the numerous specimens examined the number of laminæ varied from 44 in a small specimen to 1120 similarly arranged laminæ in a larger one. The transition between the petiolar and trunk structures was not only observed in all stages from many fragments, but specimens were studied in which stem and petiole are organically united, demonstrating not merely that *Lyginodendron Oldhamium* is a true fern, probably belonging to the Sphenopterids, but also that the stems of some, at least, of the Carboniferous ferns "developed their xylem or vascular structure exogenously through the instrumentality of a meristemic zone of the innermost cortex, which practically must be regarded as a cambium layer."

Additional observations on the growth of *Heterangium Grievii* are contributed, without establishing its true affinities, though it seems likely eventually to prove to be a fern. The discovery of the vegetative organs of *Bowmanites (Volkmannia) Dawsoni* and the study of their structure shows an organization generically identical with that of the Asterophyllites described by the author in a former memoir, and the plant described by Renault as *Sphenophyllum Stephanense*. The triangular central vascular axis is the most conspicuous character in the three types. Bowmanites, though it can be regarded as generically identical with the Sphenophylla whose fruits have been definitely correlated, is most strongly allied to the Sphenophylloid type. Williamson calls attention to the fact that evidence is being obtained of the existence of Carboniferous plants whose branches bore both Asterophyllitean and Sphenophylloid leaves (a view supported by Stur's researches among the Schatzlar Calamariæ), and that Sphenophyllum and some forms of Asterophyllites should be united in the same genus. All these types, however, he regards as belonging to the great family Calamariæ, of which Equisetum is "a poor, feeble and degraded member," rather than the central type.

Washington, D. C.

On the relation between insects and the forms and character of flowers.

THOMAS MEEHAN.

Surely all must concede that those who are industriously collecting and recording facts in relation to the visits of insects to flowers are engaged in a work of great value to science. To my mind one of the weaknesses of these observers is to attach too much importance to their work. In the enthusiasm of useful discovery, it becomes difficult to believe that the facts noted by other observers can have a value equal to our own, and we must deal leniently with the friends whose weakness induces them to belittle or ignore the work of others in parallel lines. It will do no harm, while so much is being claimed for the influence of visiting insects on the form and general behavior of flowers, to note a few propositions which have been presented and proven during the past few years, and in which I think my own work has had a place, which surely show that insects are not the all important factors in many given results credited to them.

1. Many changes in the forms of flowers are attributed to the insect's touch, and it is claimed that modification has slowly proceeded through the ages responsive to these insect habits; but it is surely not denied, at this day, that change does not occur by slow modification, but by leaps, and often by leaps of a gigantic kind. Insects can do nothing here.

2. It has been shown that in the earlier stages of fertilization there is no reason why a flower may not be indifferently of either sex, and that the final determination of this matter is a question of nutrition, with which an insect can have little to do.

3. There is no question that a flower proterandrous in one district or season may be proterogynous in another—that it is wholly a matter of meteorological influence, in which an insect has no place.

4. Fertility in plants is not wholly a matter of pollination. Some plants are barren though the pollen tubes can be traced to the ovules, and myriads of fruit resulting from perfect fertilization fall in an early stage. Nutrition is of as

much importance as fertilization by the pollen in an early stage[1] in securing ultimate fruit.

5. The floral parts are modified leaves—modified by a process that lessens their vital power—and color in these floral parts is an attribute of weakening vital power, having no relation to the visits of insects.

6. Plants wholly dependent on insects for fertilization are all perennials. An innumerable number of the flowers of these plants fall unfertilized, and but for their being perennials, many species so dependent would have long since disappeared.

7. All annuals, though in some cases so arranged that cross-fertilization may occur, can self-fertilize when cross-fertilization fails. In fact annuals are in a general sense self-fertilizers. In almost all cases annuals have every flower fertile.

8. Flowers do not abhor own-pollen, as the proposition once enthusiastically ran. No flowers are so truly fertile as those of the cleistogene class, while the nearly allied class of plants which fertilize before the corolla expands are also certainly fertile. The list in these two classes has grown so large as to render the proposition cited untenable.

9. It is conceded now that variety or variation is an essential condition in the order of things,—and that there is no more reason why special forms or colors in flowers should be made dependent on the accident of an insect's visit, than are forms and colors of minerals. The forms and colors of flowers must have had an extensive range had not an insect appeared on the stage.

We must not forget that what we call the kingdom of nature is a vast organization in which a great number of smaller and inferior powers are working apparently independently, but actually in co-operation or accord with the greater ones. No one phenomenon can be fairly placed to the credit of any one direct cause. The forgetfulness of this fact leads to many an error in our theoretical deductions. At any rate the unchallenged propositions I have enumerated, show how many things have to be considered before we accept the wide generalizations presented by those who tell us of the relation of insects to the forms and characters of flowers.

Germantown, Phila.

---

[1] This proposition is commended to the author of the note on Cephalanthus, at p. 66 of this volume

BRIEFER ARTICLES.

A suggestion on the proper terminology of the spermaphytic flower.—Faults in botanical terminology are, as in all other branches of science, very numerous. The more striking ones may perhaps be classed under a two-fold grouping—those which represent actual differences of opinions among authorities or different methods of naming the same phenomenon and those which indicate the *vis inertiæ* of the science on account of which universally abandoned notions are perpetuated by the retaining of the unmeaning or misleading words which were applied when erroneous ideas regarding anatomy, development and homologies were the only ones known to botanists. Of the first mentioned group the words Phanerogam or Gymnosperm are good examples. No one supposes that the Phanerogams are really the plants in which fertilization is distinct—as was the notion of Linnaeus. The word to-day may be applied to the group of plants which produce embryos and pollen-tubes—the Embryophyta Siphonogama of Engler, or it may be defined as the group which produces seeds and suspensors, or as the group in which one may distinguish the three embryonic layers of Hanstein and secondary endosperm. It makes no difference; the word is good enough if one defines it correctly. Whether one says Anthophyte, Spermaphyte, Seed Plant or Phanerogam is unimportant. So whether one defines the Gymnosperms as seed-plants with apical cells as Van Tieghem defines them, as Archispermous flowering-plants after Strasburger, as polyembryonic seed-plants, as seed-plants with suppressed secondary endosperm, as flowering plants with uncompressed floral axes; whether one accepts the view of Eichler regarding the homology of the cone or that of Baillon is of no importance. In any case the words are correct enough and express very well what one wishes to express when one uses them.

The other group of erroneous terms can not be dismissed so lightly. One of the most confusing places for the novice in botany is that part of the ordinary text-book which treats of the flower. The old and mistaken notion that flowers contain male and female organs took such hold of the authors on botany that, to this day, although it is about fifty years since the idea was abandoned, one can find nothing but confusion in the terms which are applied to the various phases and parts of flowers. Gray[1] speaks of hermaphrodite, unisexual, male and female flowers; Sachs of hermaphrodite flowers, of sexual organs—meaning stamens and pistils[2]; Gœbel of unisexual flowers and

[1]Structural Botany p. 191.

[2]Physiology of Plants, Eng. tran. p. 789 and elsewhere.

hermaphroditism, of male and female flowers[3]; Bessey of the female flower of Gymnosperms[4]; Luerssen of the male and female organs, of male and female flowers (die Geschlechtsorgane, männliche Blüthe, weibliche Blüthe, etc.)[5]; and one can hardly find an author of note who does not thus perpetuate in his terminology notions which he must certainly have abandoned and desires to guard others against adopting.

Now in this case there seems to be no excuse for such looseness. If biology is to be an exact science it should use its terms as the chemist or physician does. Acids must not be called bases, magnetism must not be called heat, electricity must not be called thermodynamics. Let it be remembered that reproductive cells are of two kinds, those formed by division of an existing plant-body, namely spores, and those formed by fusion of gametes, namely eggs. A plant which produces pollen-grains, embryo-sacs, conidia or any kind of spore is a spore-bearing plant or sporophyte (in the widest sense); a plant which produces gametes (whether they be isogametes as in *Ulothrix*, *Mucor*, *Syncephalis*, or spermatozoids and eggs—both or either) is a gamete-producing plant or gametophyte. We may then use our terms correctly as follows:

Gametophyte group.	*Sporophyte group.*
Hermaphrodite.	Monoclinous, diclinous.
Unisexual, bisexual.	Monoecious, dioecious.
Male, female.	Staminate, pistillate.
Spermatozoid, egg.	Microspore, macrospore.
Fertilised egg.	Macrosporophyll, microsporophyll.
etc.	etc.

We may speak of hermaphrodite, unisexual, male prothallia of ferns, if we like, but we should certainly say monoclinous, monoecious, microsporophyllous flowers. The general adoption of some uniformity in the applying of names to flowers and parts of flowers would not only make all discussions of them clearer but would not do learners the injustice of forcing upon them the very ideas which it is deemed important they should not get.—CONWAY MACMILLAN, *Minneapolis, Minn.*

Curious case of germination in Citrus decumana.—I received a few days ago from Prof. Le Baron R. Briggs, of Harvard University, half of a fruit of *Citrus decumana* on the cut surface of which was a seed which had begun to germinate. The hypocotyl was, at the time, a

[3]Outlines of Classification and Special Morphology, Eng. tran. p. 347.

[4]Botany, 5th edition, p. 397.

[5]Systematische Botanik ii, 193.

quarter of an inch long, and the well formed cotyledons had already separated, showing the plumule which had just begun to expand. What is to be noted as curious in this case, is the fact that the seed had germinated in the intact fruit, and the cotyledons and plumule were dark-green in color. Normal germination of seeds under such circumstances is so rare that one naturally is lead to suspect that some mischievous person had inserted a germinating seed into the fruit after it had been cut open. This possibility is excluded by the positive statement of Prof. Briggs, that the fruit was brought to his table perfectly intact, that he saw it cut open, and at once noticed the green seedling which was in the center of the fruit, just where the cut was made, and escaped injury except that a small part of one of the cotyledons was cut away by the knife. The testimony is so positive that suspicion of deception is excluded, and we must believe that the seed actually germinated and bore green cotyledons and plumule while enclosed in the sound fruit.—W. G. FARLOW, *Cambridge, Mass.*

Coursetia axillaris, n. sp.—Shrub or small tree (?), the younger parts pubescent : leaves small, odd-pinnate; leaflets 3 to 5 pairs, reticulated, almost glabrous above, somewhat pubescent below (as is also the rhachis), 3 to 8 mm. long, obtuse, the lower pair orbicular, the upper pairs obovate : flowers axillary, on peduncles 4 to 10 mm. long : calyx pubescent, 4 mm. long, with 5 broad equal teeth (the 2 upper ones high connate): petals about equal in length; vexillum very broad (12 mm.) and reflexed; wings oblong: vexillary stamen free; the others equal: style slender, very hairy above the middle: ovary 2 to 8-seeded: pod 2-valved, glabrous, 3.5 cm. long, with lobed margins and on a broad stipe.—San Diego, Texas, April, 1891, (*G. C. Nealley*, 16). This plant is interesting as being an intermediate form between two closely related genera, Coursetia and Sabinea. While the general characters are those of Coursetia, the inflorescence is that of Sabinea. In habit and pods it is nearest C. glandulosa of Arizona and Mexico.—JOHN M. COULTER, *Crawfordsville, Ind.*

EDITORIAL.

A MOVEMENT has begun in Indiana, which may lead to good results. A teacher's "reading-circle" has been organized for some years, containing, it is claimed, 30,000 members. Different subjects are selected each year, and an executive committee directs the proper books to be read. It has been found very profitable to publishers to secure the

sale of 30,000 copies of any book they own, and to furnish with the book an "outline of study." It is not our province to speak in general of the books used, but since botany has been made one of the subjects of the present year, we may be justified in commenting upon the character of the work proposed. We are free to say that if the whole range of botanical literature had been searched, no more unsuitable book could have been found to give these teachers any conception of modern botany.

It was with a feeling of curiosity that we have watched for some of the results; and they have come speedily enough in the shape of numerous letters from these struggling teachers. Their general opinion seems to be that if this is botany, they want no more of it. They are not to be blamed, for feeding on husks is never an inspiring diet; it only inspires a strong desire to leave the country of husks as speedily as possible. It is as if they were studying English literature, and instead of being directed to a study of the great masterpieces were told to memorize an English dictionary. In the "outline of study" which accompanies this glossary (by courtesy called a "botany"), a ludicrous attempt has been made to get into the current of laboratory methods. By a strange fatality, every plant whose examination is called for either does not grow in Indiana, or is to be secured months away from its natural time of appearance.

The prominent result of all this has been to disseminate a wide feeling of disgust for one of the most delightful of sciences; and the study of botany in the schools of the state has received a terrible backset. The possible movement for good, referred to in the opening sentence, is one just inaugurated by the Indiana Academy of Sciences, a thoroughly organized and vigorous body. The schools of the state and the scientific men are both so completely organized, that the influence of one can be easily brought in contact with the other. A committee of the Academy has been appointed to devise measures for securing a better grade of science teaching in the schools, and to attempt to counteract the influence of "reading circle" science. As the committee has been organized, not simply to draft resolutions, but to enter upon a practical campaign of hard work, we may look for some good results.

It has occurred to us that it would be well for scientific men all over the country to attack this problem in a more organized way. It is easily seen that as students pass from our well-equipped laboratories and become teachers in these schools, the leaven of scientific methods is slowly working its way through the mass. But as yet, the mass is so

vast, and the leaven is so small, that organized effort on the part of leaders in scientific work might hasten the movement.

THE SECOND part of Prof. Conway MacMillan's paper on "the three months course in botany" appears in *Education* for April. Had we anticipated another installment, we should have avoided a premature criticism, even inferentially, of his views, which are shown to be essentially in accord with those of the GAZETTE, ante, p. 120.

CURRENT LITERATURE.

Trelease on Epilobium.[1]

This is one of the most complete and satisfactory monographs we have seen. The genus is one of most perplexing character, for the species intergrade interminably. The author has wisely restrained himself from acknowledging as species all the forms that have been described as such, but he has felt compelled to publish several new ones. Not only is the geographical distribution of the species briefly considered, but the biological features connected with means of vegetative propagation, pollination, and dissemination, are noticed with that wealth of information and literature known to be in the possession of the author. The range is that of Gray's Synoptical Flora, here shown to contain 38 species of Epilobium. The new species are E. ursinum, E. holosericeum, E. delicatum, and E. clavatum, the first two from California, the others from the extreme N. W. states. Fourteen of the species admitted are those of Haussknecht. It would be impossible here to enumerate the changes in nomenclature involved by this monograph, as there has been such a confusion of names that only the monograph itself can make them clear. The names as they appear in Watson's Bibliographical Index are not very materially changed, but the separation of unrecognized species by Haussknecht has added many new names to that list. The illustration of every species is a very valuable feature of the work; and this leads us to remark, that accurate figures should be more extensively used in such monographs; for however faulty the text may be, good figures are records of facts that cannot well change, and are only second in value to the plants themselves.

[1] TRELEASE, WILLIAM.—The species of Epilobium occurring north of Mexico: 50 pp. 48 plates: 8 vo. [Reprinted from second annual report of the Mo. Bot. Garden: issued April 22, 1891.]

Baillon's "Histoire des Plantes."

The tenth volume of this great work, bearing the imprint of 1891, is at hand, and the American botanist always turns over its handsome pages with the greatest interest to discover the changes which affect his own plants. The present volume contains 476 pages, with 335 figures in the text, the families treated being Bignoniaceæ, Gesneriaceæ, Gentianaceæ, Apocynaceæ, Asclepiadaceæ, Convolvulaceæ, Polemoniaceæ, Boraginaceæ, and Acanthaceæ. In a somewhat hasty examination the following facts were noted with reference to North American plants:

GENTIANACEÆ.—*Frasera* Walt. is included under *Swertia* L.

APOCYNACEÆ.—Our single species of *Trachelospermum* is referred to *Forsteronia* G. F. W. Mey.; while the genus *Gelsemium* is included, having been transferred from Loganiaceæ.

ASCLEPIADACEÆ.—A wholesale merging of genera is made, by including *Gomphocarpus, Asclepiodora, Anantherix, Podostigma, Schizonotus*, and *Acerates* under *Asclepias*. *Vincetoxicum* Mœnch is placed under *Cynanchum* L.

CONVOLVULACEÆ.—*Calystegia* R. Br. is restored to generic rank, and *Bonamia* Dup.-Th. replaces *Breweria* R. Br.

POLEMONIACEÆ.—*Collomia* Nutt. is restored to generic rank, and all that was formerly *Gilia* becomes *Navarretia* Ruiz & Pav. Thus the name of one of our largest North American genera disappears, and a large harvest of species awaits the writer who first lists our species of *Navarretia*. How *Collomia* is kept distinct is not at all clear to the writer.

BORAGINACEÆ.—As is to be expected, the greatest changes are to be found in this much worked over group, and they are exceedingly hard to follow in any hasty review. However, the following facts seem clear: The whole family *Hydrophyllaceæ* appears under *Boraginaceæ*, and a well known ordinal name thus disappears. *Echinospermum* Swartz becomes *Lappula* Mœnch. *Eritrichium* Schrad. again appears with a part of its former species. *Cryptanthe* Lehm. also contains some former Eritrichiums. *Piptocalyx* Torr. stands for *Krynitzkia* Fisch. & Meyer. Professor Greene's genera *Eremocarya, Oreocarya, Allocarya*, and *Sonnea* are admitted, containing species variously referred heretofore to *Eritrichium* and *Krynitzkia*. *Plagiobothrys* Fisch. & Mey. is maintained, and includes *Echidiocarya* Gray. *Hydrophyllum* becomes *Hydrophyllon*. *Nemophila* Nutt. is merged under *Ellisia* L. *Draperia* Torr. goes to *Phacelia* Juss. With such an upheaval in our generic lines it will be a work of considerable difficulty to properly locate our species.

ACANTHACEÆ.—*Gatesia* Gray is reduced to *Dianthera* L.

Minor Notices.

The study of aquatic plants is rapidly increasing. Since Dr. H. Schenck published his two large papers upon the anatomy and biology of these forms, a French botanist, Mr. C. Sauvageau has given some very exact observations upon the anatomy of several aquatic monocotyledons. It may be of interest to botanists in this country to know these works, which certainly encourage further studies. They are all published in *Journal de Botanique* and the titles are as follows: Sur un cas de protoplasme intercellulaire (1889); Sur la racine du *Najas* (1889); Contributions à l'étude du système mécanique dans la racine des plantes aquatiques: Les *Potamogeton* (1889); *ditto: Zostera, Cymodocea* et *Posidonia* (1889); Observations sur la structure des feuilles des plantes aquatiques: *Zostera, Cymodocea* et *Posidonia* (1890); Sur la feuille des *Hydrocharidées* marines: *Enhalus, Thalassia* et *Halophila* (1890): Sur la structure de la feuille des genres *Halodule* et *Phyllospadix* (1890); Sur la tige des *Zostera* (1891).—T. H.

Professor F. Lamson-Scribner is the author of a small, but very readable and useful book on fungous diseases of the grape and other plants, just published by J. T. Lovett Co., of Little Silver, N. J. The diseases of the grape have recently been receiving very large attention, and from no one more than Professor Scribner. He, therefore, speaks first-hand and does not merely compile current information. Other diseases treated are those of the apple, pear, peach, plum, etc. The diseases are not only described in a simple and recognizable way, but the best known treatment is suggested. The book should be in the possession of every horticulturist.

The third biennial report of the California State Board of Forestry, for the years 1889–90, has just appeared. It is a voluminous pamphlet of over 200 pages, but is full of information concerning the forests of California. The well-known botanist, Mr. J. G. Lemmon, has collected a vast array of facts, and his descriptions are always graphic. An invaluable part of the report will be found in the 30 artotype plates, representing the general habit of characteristic trees and sometimes even their detailed structures. These photographic reproductions are always useful, for they represent a set of facts of permanent value, no matter how opinions concerning them may change.

Dr. Roland Thaxter has issued a paper on the Connecticut species of Gymnosporangium, as Bulletin 107 of the Connecticut Agricultural Experiment Station. A new species is characterized, viz. *G. nidus-avis*, the specific name referring to a "birds-nest" distortion it produces on Juniperus Virginiana. The Roestelia stage has been observed on quince and service-berry.

Prof. L. H. Bailey has found time to write "The Nursery-book," a complete guide, not to the domestic matters which the first glance at its title will suggest, but to the multiplication and pollination of plants. The seven chapters have the following titles: Seedage, Separation; Layerage; Cuttage; Graftage; The Nursery List; Pollination. The book must be of great value to nurserymen, but it is also full of information and suggestion to the botanist, who has to teach, or who wants to experiment. It is published by the Rural Publishing Co. of N. Y. City.

Mr. John Donnell Smith has just issued the second part of his very handsome "Enumeratio Plantarum Guatemalensium." This part contains 100 pages of text, printed only on one side, and gives a full enumeration of all the Guatemalan plants collected by Mr. Smith and Baron von Türckheim since the appearance of the previous part. Certain groups have been distributed among specialists of this country and Europe, and the enumeration indicates a large number of new species.

Flora Franciscana, Part I, is the title of a new publication by our indefatigable friend, Professor E. L. Greene. As the author remarks on the title-page, this is "An attempt to classify and describe the vascular plants of middle California." Twenty orders are presented, beginning with Leguminosæ and ending with Caryophylleae, the obsolete distinction between Polypetalae and Apetalae being disregarded. One expects to find all sorts of departures from ordinary methods of classification, but the vast array of facts that have been collected by the direct field observation of a keen observer make this publication a very valuable one. Probably there always will be differences of opinion as to the drawing of ordinal, generic, and specific lines, but the facts, thus pigeon-holed according to the fancy of the observer, are permanent things. It would be impossible, in this notice, to call attention to the changes proposed, for this pamphlet of 128 pages contains in almost every page things interesting enough to be noted. However, Professor Greene's views are sufficiently well known to need no explanation. This part can be obtained for 75 cents, and it should be in the hands of every student of the Pacific slope flora.

The current memoir (vol. ii, no. 3) of the Torrey Botanical Club is by Mr. Theodore Holm, who presents a paper entitled "Contributions to the knowledge of the germination of some North American plants," handsomely illustrated by 15 plates. This paper deals with the description of the germination and early stage of growth and development of the rhizomes of certain plants. It must be said that

Mr. Holm is doing a very much needed piece of work, and such contributions to our knowledge of a very much neglected subject are exceedingly welcome. It is this kind of work which is laying up in store for the future systematist a set of facts that will make it more possible to present a natural classification.

FOUR ADDITIONAL PARTS (55 to 58) of *Die natürlichen Pflanzenfamilien* have lately appeared. No. 55 contains the beginning of the Cruciferae, by Prantl, in which the generic lines in vogue in America are maintained. No. 56 contains Cunoniaceae, by Engler; Pittosporaceae, by Pax; and Myrothamnaceae, Hamamelidaceae, Bruniaceae and Platanaceae, by Niedenzu. Nos. 57 and 58 contain the conclusion of Cruciferae, by Prantl; Moringaceae, Tovariaceae and Capparidaceae by Pax; Sarraceniaceae and Nepenthaceae by Wunschmann; Droseraceae by Drude; and Resedaceae by Hellwig.

A CATALOGUE of the "Flowering plants and higher cryptogams," both native and introduced, found within about 30 miles of Hanover, N. H., has just been published by Professor Henry G. Jesup, of Dartmouth College. An outline map is included, and about 60 pages of neat text present the names and habitats of the plants of a very interesting botanical region.

THE Trans. Kansas Acad. of Science, vol. xii (1889–90) is just at hand, and contains the following papers of botanical interest: Characteristic sand-hill flora (2 pp.), M. A. Carleton; Botanical notes for 1889 (2 pp.), J. H. Carruth; Methods of collecting, cleaning and mounting diatoms (2 pp.), Gertrude Crotty; Distribution and ravages of the hackberry branch knot (1 p. and 2 plates), Germination of Indian corn after immersion in hot water (2 pp. and 4 pp. of tables), Observations on the nutation of sunflowers, (3 pp. and 40 tables), W. A. Kellerman; Notes on sorghum smuts (2 pp. and 1 plate), Kellerman & Swingle; Evolution in leaves (4 pp. and 1 plate), Mrs. W. A. Kellerman; Radiation of heat from foliage (1 p.), A. G. Mayer; List of plants from Cherokee Co., Texas (2 pp.), Mrs. A. L. Slosson; Periodicity in plants (6 pp.), Additions to the flora of Kan. (14 pp.), B. B. Smyth; The union of Cuscuta glomerata with its host (1 p. and 1 figure), W. C. Stevens; First addition to the list of Kansas Peronosporaceae (5 pp.), W. T. Swingle; On the sugars of watermelons (1 p.), J. T. Willard.

OPEN LETTERS.

A plea for better botanical specimens.

An experience of five years in two of the large herbaria of this country, in which I have handled all the specimens as they came in from collectors all over the world, has confirmed my belief that too many botanists place a greater stress on quantity than quality. The distribution of C. G. Pringle's admirable specimens during the past few years, has produced among the fortunate few of his subscribers a change of opinion for the better; and the curators of herbaria, now crowded to overflowing with inferior specimens, are throwing more and more of the worthless material into the waste-basket. If exchanging botanists would give and demand none but good, complete specimens, the standard might be raised so that each addition to our numerous herbaria would be one of permanent value, not to occupy needed space until replaced by better specimens, some time in the far future.

A common fault is the breaking up of a single individual to make it go all around. Better one perfect and complete specimen in one herbarium, than many fragments in different places. Another common fault is the sending, as a complete specimen, a single individual of the smaller species. It betrays a small soul to ask that a single *Erigenia bulbosa* or *Viola blanda* shall count one in exchange. A fault in the opposite direction is the preparing of specimens too large for the herbarium sheet. I once mounted 200 species of grasses prepared by a professional collector, and every specimen that was more than sixteen inches tall, had to be moistened and pressed over.

Many extensive collectors even yet work as if picking flowers for a bouquet, in which the stem and radical leaves are not needed. The fruiting stage seems to pass unheeded by most collectors, unless they eat the fruit instead of sending it in, as there is a great dearth of fruit among the specimens and a corresponding demand for it by some of our systematic botanists.—L. H. DEWEY, *Washington, D. C.*

Pachystima Canbyi in cultivation.

I notice in the March number of the GAZETTE that mention is made of the cultivation of *Pachystima Canbyi* in Germany. I have grown it in my garden here since 1875. I gathered it in S. W. Virginia in company with Mr. Howard Shriver in that year, and as it grew comparatively well under cultivation I have kept it in my grounds since. It is called locally "rat-stripper," from the readiness with which the bark strips off the wood, leaving a long white tail, as it were. I have sent many plants of it to various parts of Europe. The closely allied species, *P. Myrsinites*, from Oregon has not as yet proved hardy with me.—GEO. C. WOOLSON, *Passaic, N. J.*

NOTES AND NEWS.

DR. GEO. L. GOODALE has returned from his tour around the world.

A NEW GENUS of orchids, from Australia, Adelopetalum by name, is described by R. D. Fitzgerald in *Jour. Bot.* (May).

DR. LUCIEN M. UNDERWOOD has resigned his chair at Syracuse University to accept the professorship of botany at De Pauw University.

DECADES IX and X of Underwood and Cook's Hepaticae Americanae have been issued, and two more are almost ready for distribution.

DR. A. N. BERLESE has been called to the position of professor of botany and plant-pathology at the Royal School of Viticulture, at Avellino.

DR. W. A. SETCHELL, assistant in biology at Harvard University has been appointed to a similar position at Yale University. The department is under the charge of Prof. S. J. Smith.

IN THE *Journal of Botany* (May), the editor protests vigorously against Professor Henslow's theory of environment as an origin of species, as being a theory unsupported by facts.

DR. W. C. STURGIS, who has been assistant in cryptogamic botany at Harvard University has been appointed botanist to the Connecticut Agricultural Experiment *vice* Dr. Thaxter, resigned.

DR. B. L. ROBINSON, assistant in the Gray Herbarium for the past year, has been compelled to resign the position on account of ill health resulting from poisoning due to the arsenic used in preserving the specimens.

IN THE report of the Division of Forestry of the Department of Agriculture for 1890, it is shown that forestry is taught in the Agricultural Colleges of 17 states, and in 8 of them it is only incidentally touched upon.

VASEYANTHUS is a new genus of cucurbits from Lower California, described in *Zoe* (Feb.) by A. Cogniaux. Associated with Dr. George Vasey in the name is that of his assistant Mr. Rose, the plant appearing as V. Rosei.

A CATALOGUE of Nebraska phanerogams has been published by Professor Swezey, of Doane College, Crete, Nebr. The list, numbering 533 species and varieties, contains only those plants represented in the college herbarium.

DR. ROLAND THAXTER, of the Connecticut Agricultural Experiment station, has been elected assistant professor of the cryptogamic botany at Harvard University. In the probable absence of Dr. Farlow next year he will have charge of his work.

DR. AND MRS. BRITTON sailed for England June 6. Dr. B. takes a portion of Dr. Morong's S. American plants to Kew for determination and Mrs. B. expects to visit several of the bryological herbaria for study and comparison of American mosses.

IN THE third annual report of the Agricultural Experiment Station of West Virginia, the botanist, Dr. C. F. Millspaugh, speaks of a great variety of subjects, chiefly by way of instructing his constituency as to the noxious and useful plants of their flora.

DR. LUCIEN M. UNDERWOOD spent several months of the past winter in collecting in Florida and Cuba for the Department of Agriculture. He brought back not only a considerable collection of Phanerogams, but also a large number of Hepaticae and Mosses.

DR. E. KOEHNE, of Friedenau, well known as the editor of Just's *Jahresberichte*, and for his work upon the Lythraceae and other orders, has been invested with the title "Professor"—a title of more difficult acquisition, and hence more honorable, in Germany than in this country.

THE POISONING of plants having proved ineffectual has been entirely abandoned at the Gray Herbarium. The tightness of cases and the handling of the sheets are relied upon to preserve the specimens. Any which become infested may be treated to a stay in CS_2 vapor, or some other insecticide.

IN THE *Bulletin of the Torrey Botanical Club* (May), Messrs. Anderson and Kelsey describe some new algae from Montana; Mr. Murray describes a new Myriophyllum from Michigan and calls it M. Farwellii from its discoverer; and Dr. Porter characterizes a new Liatris from North Carolina, to be known as L. Helleri. The Liatris is from the top of Blowing Rock Mt., Watauga Co.

IN HIS NOTES on the histology of Polysiphonia fastigiata (*Jour. Bot.* May), Professor R. J. H. Gibson concludes that protoplasmic continuity is maintained only in young cells, and that the delicate strands which appear on both sides of the "plug" in older cells represent simply a delicate fringe arising from the margin of the plug itself and quite independent of the protoplasmic contents of the canal.

PROFESSOR CONWAY MACMILLAN, in *Amer. Nat.* (Feb.), gives an interesting table showing the comparative distribution southward of certain distinctly boreal genera of phanerogams by the Rocky and Appalachian mountain systems. The conclusion drawn is that the loftier mountain ranges have caused the extension southward of a correspondingly larger number of species. The table, as prepared, shows that twice as many species of northern genera have come southward along the twice as lofty Rocky Mountains as along the Appalachians.

M. PIERRE VIALA describes in the *Revue générale de Botanique* for April a disease of the vine which has caused considerable loss to the nurserymen in the central and southwestern parts of France during the past three years. The malady attacks the grafts and prevents the union of the stock and scion, which are usually kept for some time in sand in order to retard the growth of the buds until the proper season. Sclerotinia Fuckeliana is the cause of the trouble, and it seems to be transmitted from year to year in the sand. A thorough drying of this in the sun before using seems fatal to the spores and a preventive of the disease.

A PRIVATE LETTER from Lt. R. E. Peary, of the U. S. Navy, who proposes to attempt to reach the north pole on foot through Greenland, contains the following information that will be of interest to botanists: "I leave this country next June for Whale Sound, Greenland, from which point as a base I propose to determine the northern terminus of Greenland over the inland ice. I expect to be absent from 1½ to 2½ years. The region about Whale Sound is rich in Arctic plants, Kane having brought home 106 species of Phanerogams, and 42 species of Cryptogams, several of which were new. I am under the impression that with the exception of the above collection, and Hayes' from the same region, there are few plants from the Greenland higher latitude in this country, and that fresh specimens, subjected to modern methods of scientific research, would yield valuable results. Some specimens which I brought home from Greenland in 1886, have been considered valuable." Since the above was written, arrangements have been made with Lt. Peary to turn over his collections to the Philadelphia Academy of Sciences.

It is a well-known fact, that abnormally developed leaves are far from rare in nature, but one of the most peculiar forms is undoubtedly that to which Russell has called attention.[1] It is the so-called ascidia-form which has been observed in several families, although as a mere abnormity. The appearance of such leaves varies from cornet-like, where the two margins of the blade of a leaf have grown together at the base, to hood-like, where the margins are entirely united for their whole length. This last form has been observed by Russell, in the leaflets of the uppermost leaves of Vicia sepium, intermixed with cornet-shaped and normal ones. In these abnormal leaflets, the cells of the mesophyll have increased enormously in size, forming a nearly solid tissue. The shape of the cells of the two lowest strata of the mesophyll, especially those just under the inferior epidermis and close to the midrib, has also been transformed. They have become much higher than broad, very much like the palisade-tissue of the superior face. The fibro-vascular bundles have been moved towards the superior face of the blade, but have not been modified essentially. Chlorophyll was rather scarce in these abnormal leaflets. This transformation is due to puncture of an insect made in the superior epidermis. Larvae were found in the younger ascidia, probably belonging to a Cecidomyia.—T. H.

[1] Étude des folioles anormales du *Vicia sepium:* Revue générale de Botanique, no. 23.

C. E. Faxon del.

B. Meisel, Lith Boston

FIMBRISTEMMA CALYCOSA, n. sp.

C E Faxon del

B Meise Lith Boston

BESLERIA PANSAMALANA, n sp

C E Faxon del

B Meisel, Lith Boston

MACFADYENA SIMPLICIFOLIA, n sp

Undescribed plants from Guatemala. IX.

JOHN DONNELL SMITH.

(WITH PLATES XVI, XVII, XVIII.)

New species, described by Prof. L. Radlkofer and by Dr. M. T. Masters, are included among those of this paper.

Serjania rufisepala Radlk.—Scandens, fruticosa, glabra; rami canaliculato-6-sulcati, cortice subfusco; corpus lignosum simplex, sulcatum (fasciculis vasorum angulis subjectis corporum lignosorum periphericorum speciem interdum præbentibus ut in Serjania sordida affinibusque); folia biternata; foliola sat magna, elliptica, superiora acuminato-cuspidata, terminalia in petiolulum attenuata, lateralia sessilia, omnia integerrima, subcoriacea, penninervia, nervis lateralibus utrinque 5–6 validioribus arcuato-adscendentibus supra subtusque prominulis, utrinque glaberrima, nec nisi glandulis microscopicis adspersa, supra nitida, fuscescenti-viridia, punctis pellucidis subfuscis notata, epidermide mucigera; petioli omnes nudi; thyrsi in ramis lateralibus paniculatim congesti; cincinni sessiles; flores minores; sepala omnia rufescenti-tomentella; fructus (—immaturi tantum suppetebant) pulchre sanguinei, breviter ovati, loculis canescenti-puberulis, alis glabris.

Rami thyrsigeri diametro 4–5 mm. *Folia* circ. 20 cm longa, 14 cm lata; foliola terminalia petiolulo 8 mm longo adjecto 11 cm longa, 5 cm lata, lateralia decrescentim minora, petiolus communis 3.5 cm longus; stipulæ minutæ. *Thyrsi* circ. 7 cm longi, rhachi puberula; cincinni abbreviati; pedicelli breves, fructigeri 3 mm longi. *Flores (masculi)*: sepala interiora 2.5 mm longa. *Petala* sepalis vix longiora, intus glanduligera; squamæ superiores crista bifida appendiceque deflexa brevi dense villoso-barbata, inferiores crista oblique dentiformi instructæ *Tori* glandulæ ovatæ, basi puberulæ *Staminum* filamenta villosiuscula, antheræ glabræ. *Germinis* rudimentum parvum, trigonum, puberulum. *Fructus* (immaturus) 2–2.2 cm longus, 1.8 cm latus.—*Obs.* Affinis *Serj. sordidæ* Radlk. (Sect. xi; cf. Radlk. Serjaniæ Monogr p 272; Suppl. p. 141).

Tres Cruces, Dept. Alta Verapaz, alt. 4,800 ft., Apr. 1889, J. D. S., (Ex Pl. Guat., qu. edid. J. D. S., 1766).

Serjania psilophylla Radlk. (*Serjania spec.*, John Donnell Smith Enumeratio Plantarum Guatemalensium, Pars I, 1889, n. 1153.)—Scandens, fruticosa, glabra; rami 6-sulcati, cortice e viridi pallide subfusco, ad costas rubescente; corpus lignosum simplex, hexagonum, leviter sulcatum; folia biternata; foliola ex oblongo vel ovato lanceolata, præsertim terminalia

in acumen acutum sensim attenuata eademque in petiolulum conspicuum attenuata, lateralia in petiolulos breves contracta vel subsessilia, omnia integerrima, penninervia, nervis lateralibus utrinque 7–9 curvato-adscendentibus supra subtusque prominulis, infimis eorum reliquis vix longioribus, utrinque glaberrima, nec nisi glandulis microscopicis adspersa, nitidula, submembranacea, e viridi pallide fuscescentia, punctis lineolisque pellucidis subfuscis notata, epidermide mucigera; petioli omnes nudi; thyrsi in ramulis lateralibus paniculatim congesti, glabri; cincinni subsessiles; flores mediocres; sepala pulverulento-puberula; fructus . . . .

Rami thyrsigeri diametro 3 mm. *Folia* 18–20 cm longa; foliola terminalia petiolulo 6 mm longo adjecto 10.5 cm longa, 3 cm lata, lateralia decrescentim minora; petiolus communis 4 cm longus; stipulæ minutæ *Cincinni* contracti, circ. 6-flori; pedicelli 2–2.5 mm longi, supra basin articulati, alabastra obovoidea, 2 mm longa. *Flores hermaphroditi: sepala* interiora 3 mm longa. *Petala* ex oblongo attenuata, 3 5 mm longa, intus laxe glanduligera; squamæ (cristis exclusis) petala dimidia æquantes, margine villosiusculæ, superiores crista usque ad basin bifida (laciniis subacutis erectis) appendiceque deflexa brevi obtusa dense villoso-barbata, inferiores crista corniformi erecta instructæ. *Tori* glandulæ ovatae *Stamina*. filamenta villosiuscula; antheræ glabræ. *Germen* pyriforme, trigonum, minutim canescenti-puberulum; stylus brevis; stigmata stylum æquantia.—*Obs* Affinis *Serj. acutæ* Tr. et Planch. (Sect. xi; cf. Radlk. Serjaniæ Monogr p. 274 Suppl. p 142).

Rocks at Coban, Dept. Alta Verapaz, alt. 4,300 ft., March, 1887, v. Türckheim, (Ex Pl. cit. 1153).

Serjania rachiptera Radlk.—Scandens, fruticosa, glabriuscula; rami 6-costati, striato-sulcati, glabri, juniores tantum crispato-puberuli, cortice viridi ad costas pallide subfusco; corpus lignosum simplex, sulcatum, medulla ampliore repletum; folia ambitu triangularia, bipinnata vel pinnarum infimarum pinnulis infimis in foliolorum triades dissociatis transeuntia insupra decomposita, 6–8-juga, pinnis inferioribus 4-jugis, superioribus decrescentibus, summis foliola simplicia exhibentibus; foliola (pinnulæ) parva lateralia elliptica vel suborbicularia, terminalia subrhombea cum lateralibus proximis interdum confluentia, omnia sessilia, paucidentata, subchartacea, utrinque glabra nec nisi glandulis microscopicis adspersa, viridia, subtus pallidiora, punctis lineolisque pellucidis obsoletius notata, epidermide mucigera; petiolus communis perbrevis, nudus, margine hirtellus, rhachium omnium segmenta omnia alata, supra ad lineam medianum puberula; thyrsi solitarii vel in ramulis lateralibus paniculatim congesti, graciles; cincinni stipitati, abbreviati, puberuli; flores mediocres, albidi; sepala exteriora laxius, interiora basi densius puberula; fructus . . .

Rami thyrsigeri diametro 2 mm. *Folia* inferiora 14 cm longa, 9 cm lata; foliola terminalia 2.5 cm longa, 1 2 cm lata, lateralia inferiora (suborbicularia) diametro circ 1 cm, superiora (elliptica) minora, angustioria; petiolus communis 0.5 cm, vix excedens, rhacheos primariæ segmenta inferiora 2 cm longa, 4 mm lata, superiora decrescentim breviora pinnarum vix 1 cm longa, stipulæ parvæ, ovato-triangulares *Thyrsi* folia superantes, inferiores 16–18 cm longi, rhachi pedunculum communem glabrum gracilem apice haud raro circinatum subæquante puberula dense cincinnifera; cincinni stipite 4–5 mm longo suffulti, 7-9-flori, puberuli; pedicelli 2 5 longi, prope basin articulati; alabastra obovoidea, pedicellos æquantia *Flores masculi: sepala* interiora 3 5 mm longa *Petala* spathulata, sepala vix superantia, intus laxe glanduligera; squamæ superiores crista emarginato-bifida (laciniis acutis patulis) appendiceque deflexa brevi barbata, inferiores crista sat alta oblique emarginata instructæ *Tori* glabri glandulæ superiores semiorbiculares, inferiores minores *Staminum* filamenta pilosiuscula; antheræ glabræ *Germinis* rudimentum trigonum, glanduligerum, ceterum glabrum — *Obs* Affinis *Serj. Cambessedeanæ* Schlecht. et Cham. Sect xii; cf Radlk Serjaniæ (Monogr p 290, Suppl , p 150)

Guarda Viejo, Dept. Guatemala, alt. 5,000 ft., Febr., 1890 J. D. S., (Ex Pl. cit. 1907).

Paullinia scarlatina Radlk.—Scandens, fructicosa; rami juniores pentagoni puberuli, adultiores subteretes, striati, lenticellorum seriebus notati; corpus lignosum simplex; folia 5-foliolato-pinnata; foliola superiora ex elliptico sublanceolata, inferiora ovata, apice in acumen obtusum producta, basi superiora longius breviusve attenuata, inferiora rotundata, omnia breviter petiolulata, integerrima, vel dente uno alterove notata, chartacea, transversim venosa, praeter axillas nervorum subtus barbatas glabra, nitidula, glandulis, microscopicis curvatis obsita, utriculis laticiferis reticulatis pellucidis sat crebris supra subtusque instructa, epidermide mucigera; petiolus basi utrinque vasorum fasciculo corticali instructus; rhachis submarginata; stipulatae parvæ, triangulares; thyrsi solitarii, axillares; bracteæ bracteolæque parvæ, subulatæ; flores sat magni, sepalis 3–5 fere omnino liberis; fructus ellipsoideus stipitatus, subapiculatus, valvarum costa mediana evanina tricostatus, extus glabriusculus, intus pilis longis fuscidulis dense villosus; semen late ovoideum, ventre subcarinatum, glabrum, arillo dorso fisso usque ad medium obtectum; cotyledones oleigeræ, interior tenuior, transversim plicata.

Rami thyrsigeri diametro 3-5 mm, cortice subfusco *Folia* circ. 16 cm longa totidem lata; foliola 10–12 cm longa, 4 5–5 cm lata, sicca subfusca; petiolus communis 3–4 cm longus, supra sulcatus, rhachis paullo brevior; stipulæ 2 5 mm longæ. *Thyrsi* folia subæquantes, robusti, pedunculo quam rhachis tomentella longiore; rhachis (fructifera) diametro 2–2 5 mm, sat dense cincinnigera, cincinnis sessilibus contractis; pedicelli fructigeri 6–7 mm longi, paullo supra medium articulati *Sepala* (calycis fructiferi) tomentella, duo exteriora breviora, interiora circa 4 mm longa *Tori* glandulæ ovatæ, pubescentes. (Reliquæ floris partes non suppetebant.) *Fructus* stipite 5–6 mm longo adjecto

2.5–3 cm longus. *Semen* 1.3—1.4, cm longum, testa atro-fusca, pilorum endocarpii impressione leviter striolata, nitidula.—*Obs.* Affinis *Paulliniæ costatæ* Schlechtend. et Cham.

Boca del Cajabon, Dept. Yzabal, alt. 350, Apr., 1889, J. D. S. (Ex Pl. cit. 1662).

Spondias Radlkoferi.— Leaves 7–9 jugate, about a foot long; leaflets granular-punctate, the upper pairs oblong-lanceolate (30–38 × 10–13 l.), the lower rhomboidal and smaller, obliquely and acutely caudate, midrib and 6–8 costal nerves pubescent: pedicels bracteose at base, shorter than buds, clustered toward apex of short tertiary branches of panicle: calyx-lobes round-ovate, obtuse: disk fleshy, depressed, pulvinate, radiate, pulverulent: anthers small, quadrate: ovary 3–4-locular, styles pointed: fruit not seen.—A species, otherwise similar to *S. lutea* L., to which as probably new my attention has been directed by Prof. L. Radlkofer, the eminent monographer of *Sapindaceæ.*—Escuintla, Dept. Escuintla, alt. 1,100 ft., Apr. 1890, J. D. S., (Ex. Pl. cit. 2087).

Galactia discolor.— Fruticose, erect (2–3 ft.), cano-pubescent: stipules filiform; leaflets twice to thrice exceeding petiole, shortly and subequally petiolulate, coriaceous, green and glabrate above, silvery lanate beneath, lanceolate to elliptical-oblong (20–42 × 6–16 l.), the terminal the greater, acute or obtuse at each end, apex mucronate or retuse: racemes subsessile, short (10–18 l.); flowers 6–12, half an inch long, purple: calyx-tube shorter than pedicel and filiform bractlets, its segments 4 times longer and nearly equaling petals: the vexillary round-oval, auriculate, not inflexed, its filament free: ovary silvery lanate.— *G. Jussiæana* HBK., likewise with habit of *Collæa* and flowers of *Eugalactia*, differs chiefly by smaller elliptical leaves emarginate at base with the terminal one remote, minute stipules and bractlets, less deeply parted calyx twice exceeded by roseate petals, the vexillary obovate and exappendiculate.—Santa Rosa, Dept. Baja Verapaz, alt. 5,000 ft., July, 1887, v. Türckheim, (Ex Pl. cit. 1321).

Oreopanax oligocarpum.—Arborescent, nitidous except sparsely stellate-pubescent panicle: leaves crowded at apex of branchlets and at intervals below, exstipulate, coriaceous, entire, 3-nerved, lanceolate (6–9 × 1–1¾ in.), apex acutely produced, base acute, petioles from a third to more than half as long and tumid at each end: panicle sessile, corymbiform,

subequalling petioles; heads small (in anthesis scarcely 2 lines in diameter), much exceeded by peduncles, loosely 5–8-flowered: of masculine flowers calyx obsolete, petals 4 and equalling filaments, styles united; feminine flowers not seen: berries 3–4 to a head, globose-ovoid, sulcate, 6–7-seeded, crowned with persistent radiate styles.—*O. capitata* Dcne. et Planch., a nearly related species, differs by stipulate leaves ovate to obovate, large diffuse panicle of shortly pedunculate many-flowered heads, petals 5, long-exsert stamens and free styles of masculine flowers.—Pansamalá, Dept. Alta Verapaz, alt. 3,800 ft., Apr. 1889, J. D. S., (Ex Pl. cit. 1743). Collected also by Sor. Juan Cooper near Cartago, Costa Rica, alt. 5,000 ft., Mch. 1888, No. 322.

Parathesis sessilifolia.—All parts except nitid upper surface of leaves rufo-tomentose with long-stipitate stellate hairs: leaves oblanceolate (6–8 × 1¾–2 in.), acuminately produced, tapering from above middle to acute sessile base, pergameneous, subcrenulate, both surfaces nigro-punctate and finely reticulate: panicle terminal, exceeding leaves, pyramidate, lower branches leaf-bracted: flowers 6–10, corymbosely fasciculate toward apex of secondary branches, subequalling pedicels, in all parts linear-maculate, filiform bractlets a half shorter: sepals acutely lanceolate (½ l.): segments of corolla linear-lanceolate (2½ l.), glabrous within, revolute: anthers affixed near base, oblong (1¼ l.), thrice exceeding filament: berry 4 l. in diameter.—Peculiar by indument and sessile leaves.—Coban, alt. 4,300 ft., Aug. 1886, v. Turckheim, (Ex Pl. cit. 1443).

Parathesis pleurobotryosa.—Fusco-tomentulose: leaves elliptical (4–6 × 1½–2 in.), ends similarly acute, subentire, glabrate above, epunctate, opaque, 14–18 costal nerves distinct: panicles axillary, equalling leaves, racemiform, short branches terminated by 3–5 umbellately clustered minutely bracteolate pedicels equalling scarcely maculate flowers: corolla-segments ochracco-furfuraceous on both sides: anthers short (¾ l.), equalling filament: ovary smooth: berry not seen.—Anthers excepted flowers are similar in form and dimensions to those of preceding species. *P. melanosticta* Hemsl., (Ex Pl. cit. 1706), with inflorescence also strictly axillary, differs by glabrity, nigro-punctate oblong-elliptical leaves acuminate at apex and long-tapering into petiole with more numerous costal nerves uniting in marginal arches, com-

pound panicles, ovate sepals, half smaller white maculate flowers, lanceolate corolla-segments smooth without and albo-furfuraceous within, pubescent ovary.—Santa Rosa, alt. 5,000 ft., Sept. 1888, v. Türckheim, (Ex pl. cit. 1,442).

Fimbristemma calycosa.—Leaves oblong-cordate (4–6 in.), abruptly acuminate: peduncles (6–10 l.) exceeded by petioles, the much longer pedicels cymosely and radiately 6–8 fasciculate, flowers an inch in diameter: segments of calyx oval, pallescent: segments of corolla somewhat longer, narrower, glabrous, dark-yellow, dextrorsely convolute: exterior crown lobeless, densely long-fimbriate; lobes of the interior ovate, equalling fringe, bidentate, naked: anthers appendiculate below with a bicornute wing, caudicle nearly as long as pollen-mass: follicle not seen.—*Fimbristemma*, as limited by Turczaninow and not of Bentham and Hooker, is represented by one other species, *F. gonoloboides* Turcz., which differs *ex char.* by peduncles exceeding petioles and bifid, half larger corolla twice exceeding calyx, lobed exterior crown, lobes of the interior entire and with an inner cucullate appendage, anthers tipped with a membrane. *Callæolepium Warscewiczii* Karst., cited by Benth. & Hook. as a second species of *Fimbristemma*, is maintained by its author to be generically distinct by form of crown, and to belong by position of pollen-masses to the group of *Cynancheæ* rather than to *Gonolobeæ*, (Botan. Jahrb. viii. 360).—Chucaneb Mt., Dept. Alta Verpaz, alt. 6,000 ft., Apr. 1889, J. D. S., (Ex Pl. cit. 1,500).

EXPLANATION OF PLATE XVI—Fig 1, flowering branch. Fig 2, flower with calyx and corolla removed Fig. 3, exterior crown Fig 4, interior crown. Fig. 5, pistil Fig. 6, pollen-masses (Fig 1 is natural size, the others are variously enlarged)

Nephradenia fruticosa.—Erect virgate shrub 6–8 ft. high: leaves linear-lanceolate (6–8 × 1–1¼ in.), tapering acutely to apex and short (5–7 l.) petioled, eglandular, pale beneath, conspicuous arching veins about 15 to a side: cymes extra-axillary, scarcely half as long as leaves, pedicels exceeded by peduncle and 3–8-subfasciculate in one or two bracteose clusters: corolla rugose, 15-nerved, pale-yellow, 9 lines broad, semi-fid, tube twice exceeding oval ciliate calyx-segments, half-oval lobes naked and emarginate: processes of crown equalling gynostegium, half-free; the adnate half small, triangular, inflated and concavely bilobate at base, margin entire, prolonged into subulate free upper half; pollen-masses

attached at base: stigma convex, exumbonate: immature follicle fusiform, tapering to long stipe.—*N. neriifolia* Benth. et Hook., the nearest congener, is a herbaceous perennial with linear-oblong leaves rounded and glandular at base, ciliate corolla, adnate coronal processes cymbiform, stigma umbonate.—Rocky islands in Rio Rubelcruz, Dept. Alta Verapaz, alt. 2,500 ft., May 1887, v. Türckheim, (Ex Pl. cit. 1,251); same locality, Apr. 1889, J. D. S., (Ex Pl. cit. 1,742).

Solenophora erubescens.—Glabrous, rubescent, tumid nodes marked by an interpetiolar line: leaves oval to elliptical-oblong, the larger in the pairs 2–3½ in. long, the other a third smaller, apex acutish, base inequilateral, coriaceous, rubescent beneath, indistinctly sinuate-serrate, petioles from ¼ to ¾ as long as leaves: flowers single on shorter axillary peduncles bibracteate in middle, or few in trichotomous cymes chiefly terminal: calyx coriaceous, 5-costate, rubro-maculate, obconic (9 l.), in flower ¼- and in fruit ½-adnate, lobes ovate (2 l.): corolla infundibuliform, twice exceeding calyx, yellow, ⅔-tubular, limb expanding to 8 lines broad; lobes suberect, transversely oblong (2×5 l.), the interior the greatest and pectinate-crenate: style 2-lobulate: fruit baccate, oval (5 l.), crimson, crowned with persistent 2-lobed gland.—Habit peculiar by glabrity and small leaves.—Rocks of a waterfall, Pansamalá, alt. 3,800 ft., May 1887, v. Türckheim, (Ex Pl. cit. 731); same locality, Apr. 1889, J. D. S., (Ex Pl. cit. 1,684).

Besleria Pansamalana (*Podobesleria* Benth. et Hook.).—Epiphytal, repent, ligneous branches ascending a foot or two, pubescent: leaves shortly petiolate, unequal in the pairs, obovate-oblong (5–6 in.), the lower smaller and obovate-rhomboid, acuminate, base obliquely acute, serrulate above middle, under surface pale-pubescent: peduncles single from one or both uppermost axils, half as long as leaves, 1-flowered: calyx-segments nearly distinct, ovate (4–5 l.), green, plurinerved, the 2 exterior narrower: corolla from narrow saccate base horizontally supine, ventricosely calceiform, 14 lines long, less than half as high, crimson; throat facing upwards midway between base and ventral apex, constricted (3 l.); divisions of small limb roundish, unequal, erect: genitals included: cells of anthers forming nearly a circle, connective orbicular: disk annular: style short (3 l.), ⅓-bilobed.—Related to *B. Onogastra* Hanst. by the corolla curiously resembling the lip of *Cypripedium*, but distinct by inflorescence, calyx,

etc.—Pansamalá, alt. 3,800 ft., Jan. 1887, v. Türckheim, (Ex Pl. cit. 196); same locality, Apr. 1889, J. D. S., (Ex Pl. cit. 1,798).

EXPLANATION OF PLATE XVII —Fig 1, flowering branch. Fig. 2, corolla laid open. Fig 3, stamen Fig 4, pistil (Fig 1 is natural size, the others are variously enlarged)

Macfadyena simplicifolia.—Erect (12–15 ft.), compressed branchlets dichotomous, articulations of petioles and pedicels glandular: leaves simple, elliptical (5–7½ × 2–3 in.), acute at each end, beset with cystoliths: flowers few, opposite in terminal short racemose clusters, short pedicels little exceeding subulate bractlets: calyx lanceolate (18–22 l.), acuminate, in anthesis closed at apex and base: corolla twice longer, white, tubulose-infundibuliform, throat ½ in. wide, lobes roundish (6–9 l.): oblong anther-cells divergent at base, staminode not present: disk cupular: stigma minutely lamellate: ovules 2 to each placenta, superposed, wings hyaline: capsule not seen.—Anomalous by erect habit, simple leaves and terminal inflorescence.—Borders of forest, Pansamalá, alt. 3,800 ft., Aug. 1886, v. Turckheim, (Ex Pl. cit. 1,030).

EXPLANATION OF PLATE XVIII —Fig 1, flowering branch Fig 2, corolla laid open Fig 3, pistil with half of calyx Fig 4, anthers Fig 5, stigma Fig. 6, vertical section of ovary (Figs 1–3 are natural size, the others are magnified)

Henrya imbricans.—Stems several from base, a foot or more long, decumbent, smooth, white, nodes verrucose: young leaves small (1 in.), ovate, acuminate, mucronate, long petiolate, pubescent: spikes short, densely flowered, 2–3-subfasciculate, axillary, or leafy-bracted in a long slender terminal panicle: bractlets simulating involucres, oblanceolate, mucronate; involucres a third longer (5 l.), imbricating, valves mucronate: corolla large (6 l.), exsert in bud: anther-cells elongate-oblong.—Both *H. scorpioides* Nees and *H. costata* Gray differ conspicuously from above by simply spicate loosely interrupted inflorescence; the former also by glandulose leaves acute at base, minute roundish bractlets, half smaller flowers, elongated style; the latter also by pluricostate shortly petiolate leaves, small cuspidate involucres.—Banks of Laguna Amatitlan, Dept. Amatitlan, alt. 3,900 ft., Febr. 1890, J. D. S., (Ex. Pl. cit. 1,923).

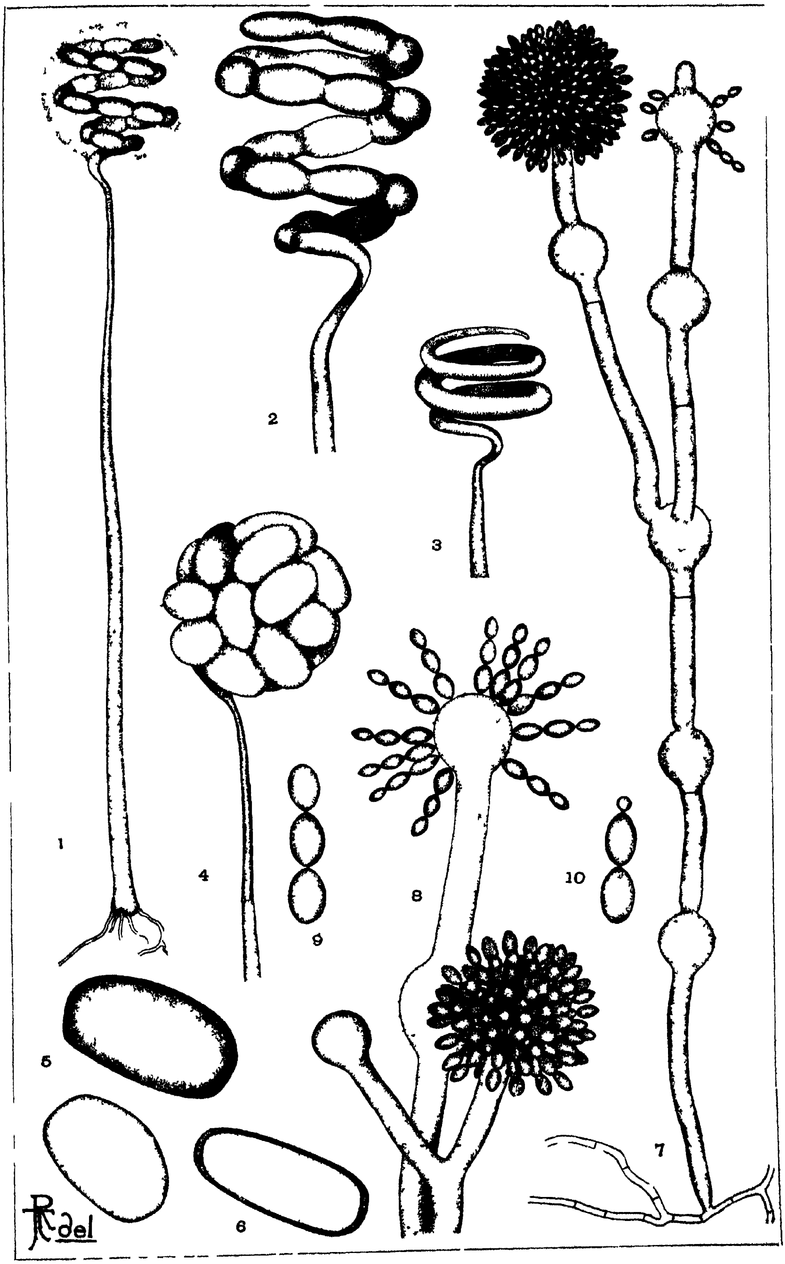
PISONIA ACULEATA L., var. **macranthocarpa.**—Spines infra-axillary, straight: pedicels of large (6 in.) cymes 1½–2 in. long; fruit obovate (9 l.), half as broad, glands long-stipitate.—Escuintla, alt. 1,100 ft., Apr. 1890, J. D. S., (Ex. Pl. cit. 2,091).

Neea psychotrioides.— Fruticose (6–8 ft.), dichotomous, smooth except rufo-fuscous pubescence of younger parts and inflorescence, branchlets terete and grayish: leaves subopposite, 4-verticillate at forks, unequal in the pairs, equilateral, oblong ($4-5 \times 1\frac{1}{4}-1\frac{1}{2}$) in., acuminate, base rounded, petioles short (2–4 l.); corymbiform cymes long pedunculate from forks of branches, subequaling leaves, axes 3–5-approximated and in fruit divaricate, cymules 3-flowered; calyculate bracts 2–4, subulate ($\frac{1}{4}$ l.), persistent: staminate perianth not seen; the pistillate nearly sessile, oval (2 l.), mouth contracted, rudimentary stamens 8–10, ovary globose, style subexsert, stigma dilated: anthocarp ellipsoid ($3\frac{1}{2} \times 2$ l.), compressed, pubescent, pluristriate, constricted below tomentulose limb.— *N. Wiesneri* Heimerl, nearly related as described and figured in detail (Botan. Jahrb. xi. 89, t. ii), differs by elliptic-lanceolate leaves dimorphous in the pair, terminal 2–3-chotomous open glabrous inflorescence, slender elongated pedicels, ovate-tubulous perianth, fimbriate stigma, glabrous terete anthocarp not striate. *N. oppositifolia* Ruiz et Pav., also related, is distinguished by elongated 5-staminate perianth, etc.— Escuintla, alt. 1,100 ft., Mch. 1890, J. D. S., (Ex Pl. cit. 2,069).

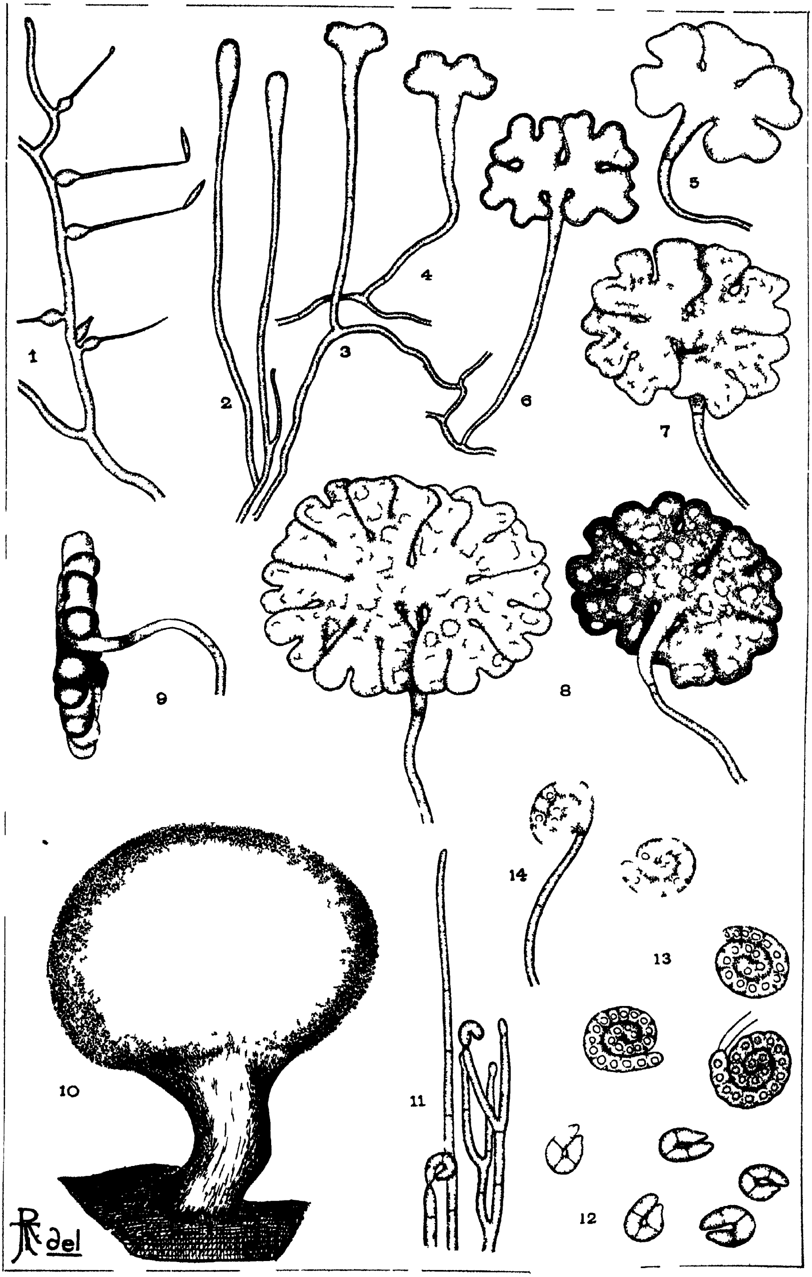
DALECHAMPIA SCANDENS L., var. **trisecta.**— Leaves glabrate, elobate and cordate-ovate, or chiefly trisect with petiolulate leaflets.— San Juan Mixtan, Dept. Escuintla, alt. 500 ft., Apr. 1890, J. D. S., (Ex. Pl. cit 2,079.)

Pirus (§ PSEUDOSTROBUS) **Donnell-Smithii** Mast.— Arbor altitudine mediocris vel humilis; ramulis crassis asperatis; squamis fulcrantibus 10–12 mm. long. subcoriaceis castaneis lanceolatis longe acuminatis margine laciniato-fimbriatis, fimbriis ascendentibus vix intertextis; fasciculis dense approximatis 5-phyllis basi vaginatis, vaginis circa 12 mm. long. e squamis lanceolatis pluribus constantibus, squamis infimis subcoriaceis ad margines integris sursum paulatim increscentibus, squamis mediis ad margines albidis longe fimbriatis, fimbriis horizontaliter divergentibus intertextis fasciculum obvolventibus, squamis summis hyalinis integris; foliis circa 13 cm. long. 1 mm. et ultra lat. rigidis triquetris ad angulos serrulatis apice subulatis, canalibus resiniferis parvis paucissimis sub epidermide positis ? vel nullis; stomatibus in utroque latere per series 6–7 dispositis; amentis masculis pluribus ad apices ramulorum capitatim-aggregatis, singulis 25–30 mm.

long. 5–7 mm. lat. erectis vel ascendentibus rectis cylindratis obtusiusculis basi bracteis subcoriaceis castaneis suffultis, bracteis infimis margine albido-fimbriatis, bracteis summis margine integris albido-limbatis; antherarum connectivis suborbicularibus erosis aurantiaco-purpureis; amentis feminiis pedunculo deflexo crasso impositis, curvatis cylindrato-conicis; squamarum apophysibus valde promimentibus deflexis carnoso-coriaceis irregulariter sub-5-angulatis carina transversa brevi notàtis, medio depressis, umbone lato deltoideo deflexo; strobilis adultis pendulis circa 10 cm. long. 6-7 cm. lat. cylindrato-oblongis apice obtuse conoideis, (squamis autem siccitate a sese separatis strobilus ovoideo-subglobosus evadit); squamis lignoso-coriaceis crassiusculis apophysibus circa 10 mm. long. 16 mm lat. rhomboideis sub-pyramidatis apice cum umbone excentrico reflexis; seminibus circa 2 cm. long. 5 mm. lat. superne alatis, ala membranacea pallide fusca angusta oblonga margine hinc paullo crassiore recta illinc tenuiore falcatim curvata.—De hac specie insigni et, ut videtur, hactenus indescripta, nec non strobilorum squamarumque notis valde distincta ita in litt. scribit oculatissimus repertor: "Abunde occurrit versus cacumen montis, et etiam ad ejus culmen, ad alt. 12,300 pèd. ubi autem arbor pumila 10-12 ped. tantum evadit." Cl. Godman etiam qui hanc speciem loco eodem observabit abhinc annos triginta tradit hancce arborem cingulam circa montem efficere ad alt. 10,000 ped. usque ad culmen aliis arboribus nullis intermixtis. In opere laudato auspiciis cl. Godman edito et a sollerte Hemsley confecto, cui nomen Biologia Centrali-Americana, vol. iii, arbor haecce obiter injecta est, nomine tamen et descriptione omnino praetermissis.— Summit of Volcan de Agua, Dept. Zacatepequez, alt. 12,300, Apr. 1890, J. D. S., (Ex Pl. cit. 2182).



THAXTER on HYPHOMYCETES



THAXTER on HYPHOMYCETES

On certain new or peculiar North American Hyphomycetes. II.

Helicocephalum, Gonatorrhodiella, Desmidiospora nov. genera and Everhartia lignatilis n. sp.

ROLAND THAXTER.

(WITH PLATES XIX AND XX)

Helicocephalum nov. gen.—Sterile hyphæ of small diameter, aseptate or rarely septate, creeping over the substratum and giving rise to highly differentiated, erect, simple, aseptate sporiferous hyphæ furnished with rhizoid like attachments at the base and spirally coiled at the apex: the spiral portion becoming septate and constricted at intervals, its segments separating at maturity in the form of large, dark colored, thick walled spores.

Helicocephalum sarcophilum n. sp—Plate XIX, figs. 1–5. Sterile hyphæ hyaline, creeping, branched, 2μ in diameter. Fertile hyphæ hyaline, 1 mm. or more in height, 20–25μ in diameter near the base and 8–10μ near the apex: tapering gradually upwards from a slightly swollen base: two or three times abruptly spirally coiled at the distal end, the spiral portion of large diameter and converted at maturity into a chain of seldom more than twenty-one spores, by the formation of successive septa. Spores brown, thick walled, with finely granular contents, asymmetrical, usually obliquely truncate, or not evenly rounded, at either end; at first hyaline then brown, $55 \times 30\mu$ (maximum $65 \times 35\mu$), separating and ultimately cohering in a viscous, rounded mass.

On carrion. Connecticut.

This remarkable form made its appearance on a laboratory culture in company with *Cœmansiella spiralis* Eidam. It is not gregarious, appearing here and there on the substratum, and closely resembles a large Mortierella or Syncephalis; the spiral portion holding a drop of somewhat viscous fluid, which gives it the appearance of a large spherical head (fig. 1). The spores mature simultaneously, falling apart and cohering as shown in fig. 4. They are very thick walled and all attempts to germinate them in nutrient media proved fruitless.

The relations of this plant are quite uncertain, no fungus which appears even remotely connected with it being known to the writer. It is placed here among the Hyphomyceteæ

from lack of evidence which would refer it elsewhere. In its mode of growth it recalls Mortierella and similar forms: but its type of spore formation, as well as the character of its spores, is quite distinct from that which occurs in any of the genera of Mucoraceæ; among which, however, it is not impossible that it may eventually find a place.

Gonatorrhodiella nov. gen.—Sterile hyphæ hyaline, creeping, septate and branched. Fertile hyphæ erect, sparingly septate, swelling into a spherical terminal sporiferous head, which after maturity may become once or twice proliferous, the proliferations also forming similar proliferating heads, the resulting hypha presenting ultimately the appearance of a successively inflated filament. Spores formed directly from short processes covering the fertile head, in chains of a definite number, by successive apical budding.

Gonatorrhodiella parasitica n. sp.—Plate XIX, figs. 7–10.

Fertile hyphæ gregarious, simple or rarely dichotomously branched, sparingly septate, hyaline becoming pale fawn colored, seldom more than five times successively proliferous, 8–12μ in diameter, sometimes more than 1 mm. in height. Sporiferous head nearly spherical to oval, rarely producing more than a single proliferation, 25–35μ in diameter, maximum $43 \times 36\mu$. Spores in chains of three, hyaline, then fawn colored, oval to elliptical, caducous, $8.5 \times 6 - 12 \times 7\mu$ the basal ones the largest.

On Hypocrea and Hypomyces. Connecticut.

This species has been met with in several localities about New Haven always growing directly upon, or running a short distance from certain species of Hypocrea and Hypomyces on which it appears to be parasitic. The genus is distinguished from *Gonatorrhodum* Corda, to which it bears a superficial resemblance, by the absence of the large, septate, subverticillate "ramuli" which give rise to the spores in the last named genus; as well as by its definite spore formation, the indefinite and often branched spore-chains of Gonatorrhodum being replaced by short simple chains composed of a small and invariable number of spores. Whether the successive apical formation of the spores in the present genus does not constitute another essential difference, cannot be determined from Corda's description; but from his figure as well as from analogy with other genera, like Aspergillus, Verticillium, etc. to which he compares it, a successive basal spore formation

may be inferred in Gonatorrhodum from the large basidia or "ramuli," as well as from the spore of the primary chain from which a secondary chain occasionally springs. The present genus is purely Mucedinous; while, as Saccardo remarks, Gonatorrhodum seems rather to belong among the Dematieæ.

Desmidiospora nov. gen.—Spores of two kinds, on the same mycelium of hyaline septate hyphæ: microconidia, small, hyaline, subfusiform, produced at the apex of subulate lateral basidia: macroconidia very large, terminal, brown, flat, multilocular, several times successively, more or less irregularly, dichotomously lobed.

Desmidiospora myrmecophila n. sp.— Plate XX, figs. 1–9. Hyphæ much branched and septate covering the host in a white flocculent mass. Microconidia subfusiform, slightly asymmetrical $12 \times 2\text{–}2.5\mu$, produced sideways at the apex of subulate basally inflated basidia. Macroconidia terminal, short stalked, three to five or even six times successively dichotomously lobed, irregularly multilocular, very thick walled, reddish brown or fawn colored, $80 \times 68\mu$, maximum $100 \times 90\mu$. $12\text{–}14\mu$ in thickness.

On a large ant. Connecticut.

This remarkable plant has been met with only once growing luxuriantly on a large black ant which was found fastened to the under side of a rotting log. The hyphæ emerged especially from between the abdominal segments, enveloping the insect more or less completely and extending a short distance over the substratum. It is not impossible that this may be an imperfect form of some Cordyceps, perhaps *C unilateralis* Tul., which is the only species of the genus that the writer has observed on ants in this vicinity. No analogous form, bearing the same relation to Cordyceps that Mycogone or Sepedonium, for instance, are supposed to bear to other Hypocreaceous genera, has been observed, as far as known to the writer. The microconidia in the present instance are, however, certainly very similar in appearance and mode of formation to conidia known to be associated with certain species of Cordyceps: yet the connection cannot be assumed and the use of a new generic name seems unavoidable. It is not unlikely, moreover, that the fungus under consideration may be mycophilous and like certain species of Gymnoascus, Thielavia, Melanospora, etc., which so often interfere with artificial cultures, be parasitic on an immature Isaria or Cordyceps previously developed within the insect.

Everhartia lignatilis n. sp.—Plate XX, figs. 10–12. Scattered, superficial, stipitate or substipitate, yellowish becoming blackish towards the base, subcylindrical or expanding upwards, 250–400×100–150μ. Spores hyaline, terminal, 3-septate, cylindrical or slightly flattened, 4μ in diameter, the rounded base and snout-like apex approaching one another in a single convolution 12–13×8–9μ: extruded in a yellow viscous rounded mass. Sporiferous hyphæ septate, subdichotomously branched, mingled with longer usually simple sterile hyphæ.

On wet logs. Connecticut.

This species occurs not uncommonly about New Haven on very rotten wet logs. It differs from *E. hymenuloides* Sacc. & Ell. in being stipitate as well as in its very distinct and smaller spores. The latter are produced in enormous quantities adhering to the apex in a yellowish viscous drop. The spores germinate readily in water, producing single hyphæ from the convexity of each segment.

EVERHARTIA HYMENULOIDES Sacc. & Ellis.—Plate XX, figs. 13–14.—Figures of the spores of this species are given for comparison drawn from material distributed in Ellis N. A. F. No. 969 on dead leaves of Sorghum nutans. In this species the sporodochia are sessile and ill defined, the spores being produced terminally on short simple hyphæ (fig. 14). The spores are formed in a helix of several convolutions, 16×20μ, and are about 3.5–4μ in diameter, extruded in a viscous mass and surrounded by a coarsely granular greenish mucus.

EXPLANATION OF PLATES

Plate XIX.—*Helicocephalum sarcophilum*, n sp.—Fig 1 Nearly mature plant showing general habit, with rhizoidal attachment at base and drop of viscous fluid held by the spiral ×136 Fig 2 Spiral portion enlarged, ×232 Fig 3 Young spiral before division has commenced, ×200 Fig 4 Spiral after maturity, the spores separated and cohering in a viscous mass, ×232 Fig 5 Two mature spores, ×696. Fig 6 A spore in optical section, ×696

Plate XIX.—*Gonatorrhodiella parasitica*, n sp Fig 7 Fertile hyphæ, showing single and double proliferation, the left hand head mature, the right beginning the fifth proliferation, ×232 Fig 8 Portions of two fertile hyphae, one simple and showing mature spore chains *in situ*, the other furcate and immature, ×348. Fig 9 Mature spore chain, ×696 Fig 10 Spore chain showing budding of apical spore, ×696

Plate XX.—*Desmidiospora myrmecophila*, n sp.—Fig 1 Portion of hyphæ showing microconidia on subulate basidia, ×348. Figs 2–6 Showing successive stages in the development of the macroconidia; ×348 Fig. 7. Macroconidium in which the transverse walls are partly formed, ×348. Fig. 8. Two mature macroconidia, ×348 Fig 10 Macroconidium viewed horizontally, ×348.

Plate XX.—*Everhartia lignatilis*, n. sp. Fig. 10. General habit showing rounded mass of extruded spores, ×68. Fig. 11. Sterile and fertile hyphae of sporodochium, showing stages in formation of helicospores, ×464. Fig 12. Mature spores, ×696.

Plate XX.—*Everhartia hymenuloides* Sacc & Ell Fig 13. Mature spores, ×696. Fig. 14. Spore *in situ*, showing terminal formation, ×696.

Notes on North American Mosses. II.

CHARLES REID BARNES.

DICRANUM PALUSTRE LaPyl.—This species has not been noted as particularly variable as is the case with its congener, *D. scoparium* Hedw. The examination of a large series of specimens, collected in various parts of the northwestern United States by Dr. Julius Roll in 1888, has shown me that it is almost as polymorphous as D. scoparium, and that it intergrades so closely with that species that it is quite impossible to limit it except in a wholly arbitrary way. The var. *paludosum* of D. scoparium imitates somewhat the typical D. palustre in the rugulose and shorter pointed leaves. But this is a character by no means constant in the latter species. Indeed it is oftener absent than present. There is also no reliable distinction to be drawn from the section of the costa. We have therefore simply to say that those forms with slender pointed often falcate leaves, having the cells somewhat elongated in the upper part, shall be grouped with D. scoparium. I have not thought it worth while to characterize separately any of those forms of D. palustre (among which the Californian variety *Brewerianum* of Lesquereux may well be placed) which connect with the palustral modifications of D. scoparium. If one should begin, the list might rival that of some of the Sphagna! On the other hand D. palustre shows numerous variations toward forms with broad leaves, entire or coarsely serrated and usually not wrinkled. Three of these I have separated as well-marked varieties,[1] which fall more or less closely into company with the European vars. *juniperifolium* and *polycladon* of the Bry. Eu. Had the intermediate forms been lacking from the collection I should have unhesitatingly established these, or at least the var. *Roellii*, as species.

Having already examined a considerable number of the species of Dicranum in determining the Weisiaceæ of Röll's

[1] Botanisches Centralblatt xliv. 386 (1890).

collection, I hope to study the remaining North American members of the genus shortly.

BARBULA MEGALOCARPA Kindb.—This is the same as *B. ruralis* var. *gigantea* Aust. MS. It is hardly worthy even of varietal rank. Indeed B. ruralis is described by Limpricht[2] as having the awn often reddish and the leaves "*meist* mit vorgezogener, *selten* gerundeter oder ausgerandeter Spitze"—characters on which Kindberg chiefly bases his B. megalocarpa.

WEBERA NUTANS Hedw.—In specimens collected by J. M. Holzinger at Winona, Minn., the cilia are as strongly appendiculate as in any Eu-Bryum. Of course such a statement without qualification would simply throw doubt upon the determination. But in this case there can be no mistake. Leaves from the very perichætium whose fruit was examined were used.

ATRICHUM ANGUSTATUM Br. & Sch.—Intermediate forms between this species and *A. undulatum* Beauv. are not uncommon, and some specimens from Washington, D. C., show lamellæ as much as 9 cells wide! One of the striking features of *A. Selwyni* Aust., of which abundant material has lately been received from the north-west, is the wide lamellæ, but they do not much surpass those on the specimens just referred to.

HYPNUM (Thuidium) PYGMAEUM S. & L.—The stems of this species are described as papillose. These "papillæ" are really short, 2—4-celled, papillose, filiform, rudimentary paraphyllia. They resemble in many ways most of the paraphyllia of H. minutulum, but are less developed. To call them "papillæ" is a misuse of the word.

HYPNUM (Claopodium) RAMULOSUM Hampe.—I think it probable that this is identical with Hooker's H. crispifolium. This opinion is not based upon a comparison of specimens for they are inaccessible, if indeed they exist. But authentic specimens of H. crispifolium agree perfectly with Hampe's (or Müller's) description.[3] Moreover this species is common in the region from which the supposed H. ramulosum comes, while that has never been collected but once. Specimens under this name in the James herbarium from Marin co.,

[2] Die Laubmoose (Rabenh. Krypt.-Flora iv.) i, 687.
[3] Mueller: Synopsis Musc. ii. 486.

California, are H. crispifolium. Finally, the descriptions themselves of the two species show no points of specific difference.

HYPNUM (Camptothecium) NUTTALLII Wils.—This species often has the seta twice or thrice as long as the capsule, instead of "scarcely as long". This is shown by the specimens in at least two sets of Sullivant and Lesquereux' Musci Bor. Amer. I. n. 338b, and also by Macoun's n. 280 Canadian Musci, issued under the name of *H. pinnatifidum* S. & L.

HYPNUM (Isothecium) BREWERIANUM Lesq.—The leaf-cells are short-ovate to rhombic. If it is to be retained under Isothecium the subgeneric character "areolation minute, vermicular-oblong" must be corrected.

HYPNUM (Eurhynchium) COLPOPHYLLUM Sull.—This species has two forms of leaves which often occur on the same plant. The younger are the narrower (ovate to lance-ovate), while the older are broader (elliptic). The narrow form approaches most closely the figures of Sullivant's Icones Muscorum Suppl. pl. 71; the wider are more like those of *E. crassinervium*, but differ from them in the points named in the Manual, p. 353. These narrow leaves often predominate, in which case the aspect of the plants is quite different, so much so as to warrant a distinctive name. This narrow-leaved form of H. colpophyllum may be designated as var. **flagelliforme** n. var.: *leaves lance-ovate, small; branches long, almost flagelliform, attenuate.* In the type the branches are short and tumid-julaceous, leaves densely imbricate and elliptic-ovate. The apiculus is often very short, or the leaves may be simply acute. There is a considerable variation also in the size of the capsule.

NEW LOCALITIES.—The following new localities may be selected from a large number as being of special interest.

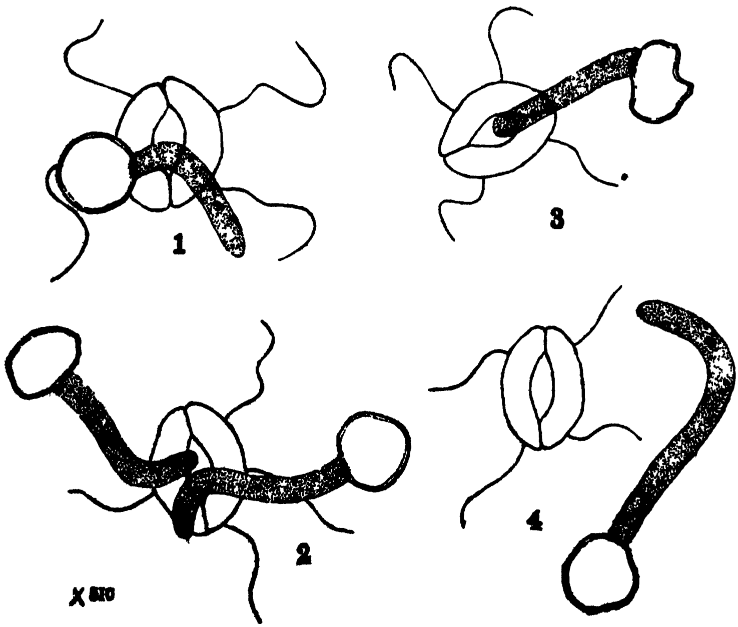
Bruchia Hallii Aust. has recently been sent me from Hockley, Texas, by Mr. F. W. Thurow, an interesting rediscovery of one of Hall's Texan mosses.—*Dicranum hyperboreum* Müll. was collected for the first time in the United States by Röll on Mt. Hood at 7000 ft. altitude.—Mr. J. M. Holzinger gathered a Coscinodon at Winona, Minn., which on comparison with the types proved to be *C. Raui*, previously credited only to Colorado.—The same excellent collector sent also from this locality *Fabronia pusilla* Raddi, *Myurella Careyana* Sull. and *Leskea Austini* Sull.

University of Wisconsin.

BRIEFER ARTICLES.

Penetration of the host by Peronospora gangliformis.— While studying the lettuce mould in the fall and winter of 1890, some observations were made by the writer on the penetration of its germ-tubes that differ from those heretofore recorded.

Spores of the fungus were sown in a drop of water upon the under surface of leaves of lettuce (*Lactuca sativa*). The leaves were kept in a moist atmosphere under a bell-glass in the laboratory. After twenty-four hours pieces of the epidermis were stripped off from the infected spots and examined under the microscope. The spores had germinated abundantly, pushing out a strong germ-tube into which the protoplasm of the spore had passed, leaving the empty, and often shriveled-up spore membrane attached to the germ-tube.



Several cases of penetration were seen, the germ-tubes pushing their way between the guard-cells of the stomata (figs. 1, 2 and 3). In other instances the germ-tubes had approached quite up to a stoma, but had not yet penetrated (fig. 2). Very many of the germ-tubes had grown straight forward for a time, and had then made a rather sudden turn, directing the terminal portion toward a stoma in the vicinity (figs. 2 and 4).

These observations are confirmed by those of Mr. A. J. Pieters, who obtained results from sowings of spores upon leaves of a growing plant. No cases of penetration through the walls of epidermal cells, as is said by De Bary[1] to be the rule for this species, were observed.— W. H. RUSH, *Botanical Laboratory, University of Michigan.*

EDITORIAL.

BOTANY is making a healthy and vigorous growth in the United States. Never before have there been so many teachers, so many investigators, or so many collectors advancing the interests of the science and making its merits known to the public, as at the present time. Probably no field of the science is now wholly without workers, a statement that could not have been made a few years ago; and what is really more to the purpose, a constantly increasing proportion of the work accomplished has a permanent value and attains a rank of commanding importance.

THE ORGANIZATION of the Botanical club of the A. A. A. S., in 1883, gave a decided impetus to American botany, and especially effected an improvement in the character of the investigations undertaken by individual workers. The movement set on foot last year in the same association, by which a prearranged series of papers covering certain portions of the higher grounds of the science is presented each year, must also prove valuable. These and other means for raising the standard of work for the individual, and for strengthening the reputation of the science among its friends, have already shown good results and justified the efforts put forth.

SO MUCH has already been accomplished that even greater things may be confidently looked for in the future. The coming meeting at Washington, which promises to have a larger attendance of botanists than ever before, should bring forth some new plans for general or co-operative work. Things may be accomplished by the united interest and effort of the many that would be difficult or impossible for single workers. So plain a truth needs no illustration, but its appreciation in solving specific problems may require considerable enforcement.

A MATTER to be borne in mind for the coming meeting is the unique opportunity afforded by the approaching World's Fair to secure some benefits for botany. A few European visitors of eminence may cer-

[1] Ann. d. Sc. Nat Bot. sér. 4. xx.

tainly be expected, and an unusually full gathering of American botanists. Hundreds of industrial and other societies are arranging for memorable occasions, and if some of this enthusiasm could be turned in the direction of pure science the result could not fail to be beneficial.

ANOTHER matter not quite as distant may be suggested here. In connection with the papers upon physiological subjects at the Washington gathering, why not exhibit a collection of physiological apparatus? If each laboratory would send a few pieces the display would be made very interesting.

CURRENT LITERATURE.

Practical Botany[1].

The first edition of the Strasburger's Kleine Botanische Practicum published in 1886 has been one of the most useful of the handbooks of recent years. It had its defects, some of which were pointed out in this journal (vol. xii. 91) but they were not such as to seriously impair its usefulness. In this revised edition the author has much improved the book. Considerable additional matter has been inserted, notably in chapters xi, xxii, xxiii, xxvii, xxviii and xxx, and chapters ix and xxi have been almost entirely rewritten. Altogether 52 pages have been added and there are about 20 new figures. It is extremely difficult to make such extensive changes fit in with the old stereotyped plates. This has been done however with a minimum of injury to the appearance of the book, only a few pages being unduly leaded. One could have wished however that so many of the page numbers had not been carried to the inner edge of the page, and that when change was being made these might have been transferred where necessary so as to stand in their proper place.

The figures of the present edition are much better printed than in the first. They now compare favorably with those of the German edition. In every way the book is well manufactured. The suitable paper and loose binding are especially commendable in such a laboratory guide. We hope that it may by reason of these betterments meet with a still wider sale in this country.

[1] STRASBURGER, EDWARD,—Handbook of practical botany, for the botanical laboratory and private student. Edited from the German by W. HILLHOUSE; revised by the author, and with many additional notes by author and editor Second edition, revised and enlarged. 80 pp. xxiv. 425 (+ 52) figs. 149. New York: Macmillan & Co. [London: Swan Sonnenschein & Co.] 1889.

The new Gray's Manual.[1]

The revised (6th) edition of the Manual has been fully noticed in this journal (xv, p. 71). No one who has had any experience in book-making was surprised that there should occur a considerable number of errors and omissions in the first issue of this edition and some of the reviews of the book would have been less absurd had their writers taken some account of human fallibility. In this second issue an attempt is made to give "all such needed emendations of every kind as have come to our [the authors'] notice. Whenever it could be conveniently done these alterations have been made in the plates." The remainder are printed on four pages following p. 735 (designated 735 *a*, etc.) The corrections in the plates are numerous—over 100 of one sort and another. Seventeen species appear among the "supplementary additions and corrections"—and two genera, Franseria and Paulownia.

The pocket edition of the Manual is a gem in its way and certainly "fills a long-felt want." It weighs only 14 ounces and is about ⅞ of an inch thick—just the thing for carrying easily. It is bound in delightfully soft flexible leather, and looks as though it would be durable. We can suggest only one improvement short of India paper and silk-sewing—that is, slightly rounded corners, so as not to catch on the pocket. No botanist who has a copy of the library edition will ever carry that with him after he has seen this. The American Book Company has merited our gratitude for dressing this volume so serviceably and at the same time so handsomely. The *very low* price ($2) will certainly make this as popular as it is handsome.

Introduction to the Study of Botany.[2]

He who gets an introduction to the science of botany through the medium of this book will probably have little inclination to cultivate the acquaintance. If this book is a fair indication, Mr. Edward Aveling, D. Sc. (God save the mark!) has need himself to be introduced to the fair science whose most difficult task he has essayed without adequate knowledge.

---

[1] GRAY, ASA.—Manual of the botany of the northern United States. Sixth edition, revised and extended westward to the 100th meridian by Sereno Watson and John M Coulter. 8° cloth. pp. 760 (+ 4). plates xxv. New York: American Book Co. 1891. $1.60.

The same, pocket edition, 4¼ × 7½ inches, full leather, flexible. $2.

[2] AVELING, EDWARD.—An introduction to the study of botany. 12° pp. iv. 363. figs. 271. London: Swan Sonnenschein & Co. (N. Y.: Macmillan & Co.), 1891.

The book takes as its "basis the syllabus of subject xv, botany, from the Science and Art Department" of South Kensington, and proceeds to expound the science from this "examinational" standpoint. It is perhaps a fair inference that this "basis" is somewhat narrow, for we read early: "Broadly, biology is the science that deals with living bodies. General biology, as understood *in the examinational sense*, considers certain typical living bodies in their structure and life-history." We should have no quarrel, however, with the basis, were the superstructure sound.

In the body of the book eighteen flowering plants are described with considerable detail, the object, apparently, being to introduce as many terms, with their definitions, as possible. Then follow chapters on the vegetable cell, cell contents, tissues and systems, the root, stem, leaf, inflorescence, floral organs and fruits. A glossary—are we never to get rid of this as the animus of elementary botanical text? Not content to have the book mainly such, the author urges "upon the student and teacher the importance, the necessity, of everyone constructing his own glossary. The earnest student will, as he meets with each new word, then and there enter it in his vocabulary. At the end of this volume will be found a glossary put together by me, and this the student can compare with his." Here is a sample of it:

WORD.	DERIVATION.	DEFINITION.	EXAMPLE.
Thorn.	. . . .	A modified organ, hard and sharp	Sloe
Tissue.	. . . .	A constituent of an organ	Parenchyma or muscle.
Tripinnate.	tres, three; pinna, a leaflet.	Divided into three leaflets.	Leaf of hemlock.

It is to be hoped that the student will succeed better than the author, for of the three definitions, selected at random within a space of seven lines, not one is accurate. And why should not the derivation of "thorn" and "tissue" be sought out, as well as that of words with Greek and Latin roots? But what is the use of any of it? Would a student of English literature be urged to construct for himself an English lexicon?

Dr. Aveling makes much of derivations however. Witness the following: "The upper [leaves] have no stalk or petiole, and are therefore said to be sessile. *Sedeo, sedi, sessum, sedere,* I sit." Why omit the rest of the coujugation? "The particular kind of inflorescence is therefore a *corymb.* κορυμβος, (*korumbos*) a cluster of fruit, especially of ivy-berries (Vergil, 'Bucolics,' Ecl. iii. 39)." To which the skeptical are respectfully referred. And this (verbatim) is particularly good: "the Orpine is of the order Crassulaceæ, thus named from the thickness of its leaves. *crassus,* thick. Species, *Sedum;* genus, *Telephium. Sedum,*

from the sessile nature of the genus; *Telephium*, in the old over-classical fashion, from Telephus, the son of Hercules."

The author is evidently enamored of tabular arrangement, for he introduces tables, big and little, fragmentary and complete, at every available point.[1] Here is one at random, from which their value may be judged: "The fruit of the hazel can be worked out by reference to the fragment of the complete table given on p. 137." Then the entire page 137 is devoted to this, by means of which the fruit of the hazel ought to be "worked out" without severe mental strain:

FRUITS
- monogynœcial.
  - simple.
    - syncarpous.
    - apocarpous..
      - each carpel with one seed.
        - superior.
        - inferior.
      - each carpel with more than one seed.
  - compound.
    - superior.
    - inferior.
      - 1-celled, with cupule—GLANS.
      - 2-celled.
- polygynœcial.

Page after page is covered with these "fragments," which are gathered up, warmed over and spread out again in later "tables."

As specimens of the information imparted by this "introduction" read the following:

"The common name for the gynœcium [of the Buttercup] is the pistil."

"Consider now only one carpel. It is clearly monogynœcial."

"Raceme . . . *Racemus*, a bunch of grapes, one of the best examples of this kind of inflorescence."

" . . . glaucous. This last word is used for a surface of excessive, shiny smoothness."

"The rootstock of the Cyclamen is a tuber. The most familiar example of a tuber is a potato. The tuber of the Cyclamen is a rootstock structure; that of a potato is formed from a branch . . . and is therefore a stem structure."

Here is a bit of technique: "And even in their case [leaves of Sedum and Hyacinth] it is wise to cut up the leaf into fragments, throw the pieces into melted paraffin, and when this has cooled and solidified, make thin sections through this and the embedded leaves." The naiveté of these directions will be very impressive to those who know the paraffin process.

After five pages on these subjects, good, bad and indifferent, the author avers that "The cell-wall, protoplasm, nucleus, starch grains, aleurone grains are now understood." That and the following which comes from near the close of the book must prove very cheering to the weary student: "If the student will now turn to the syllabus of the

[1] No less than 10 per cent. of the pages are occupied with such tabular views. Another 10 per cent. the glossary takes.

Science and Art Department printed in our first chapter, he will see that we have cleared off [but not up] not only the whole of the general morphology, histology and physiology, but also . . . "

Here is the beginning of the discussion of vessels: "A vessel in botany [sic] is formed out of a number of cells placed vertically one above the other, whose partition walls vanish. The simplest kind of vessels are *vasa propria* (vessels proper)—elongated cells with a thickening of the wall that takes the form of a very fine network. The student will note once again how artificial our definitions are, and how the botanical categories overlap each other. A vessel is defined as a tube formed by the fusion of several cells, and the first kind of vessel described, *vas proprium*, is made up of one cell. The second form of vessel is the sieve tube. . . . sieve tubes are also called vesicular or utricular vessels. They are common in the bulb of the onion . . . and other Monocotyledons. The sieve tubes contain a milky juice and very often crystals."

The physiology is no better: " . . . the roots take in the nitrogen-containing food-stuffs and the leaves especially take in the carbon-containing food-stuff. From the roots the former must move up until they meet the latter coming down from the green parts. When the two sets of food-stuffs meet, the manufacture of those important plant structures that contain carbon, hydrogen, oxygen, nitrogen, must occur, and from the place where this manufacture occurs, diffusion of these substances to other parts of the plant must follow. . . . This taking in of food is assimilation."

But to continue would be to occupy space to no good purpose. What we have given is not a selection of isolated blunders. It might be increased ten-fold without exhausting the supply of error and absurdity. Some of the illustrations, could we reproduce them, would be as ludicrous as the text.

We should be glad to be able to say something favorable about this book, if, even after careful search, we could find it. But the plan is crude and the execution wretched. Yet if we do not mistake the tone of the book the author feels that he has done a creditable piece of work, and the publisher hopes to gain for it a sale in this country. It is a pity that so reputable a house should be so imposed upon by a worse than worthless text-book.

OPEN LETTERS.

The Manchester group of botanists.

A PHOTOGRAPH of twenty-five botanists was shown at the Indianapolis meeting of the A. A. A. S. and a number of persons expressed a desire to obtain copies of it. As an accommodation to those who may wish a copy, I will send an order to the photographer for as many as are wanted, and distribute them upon their arrival.

The group was taken at Manchester, England, in 1886, and was the company who gathered at the hospitable home of Prof. Williamson to do honor to the visit of Dr. Asa Gray. All departments of botanical science were represented. The group embraces: Messrs. McNab, Jessen, Treub, Solms-Laubach, Weissmann, Saporta, Baker, Lankester, D'Arcy Thompson, Dyer, Cohn, De Bary, Williamson, Asa Gray, Pringsheim, Carruthers, Gardiner, Oliver, Vines, Marshall Ward, C. Bailey, Balfour, Bower, Potter and Vaizey. The picture is 10 by 12 inches, and an excellent portrait of each individual. The price will be $1.35 unmounted or $1.75 mounted on a neat card 14 by 16 inches and the names written underneath. Those wishing copies will please send in their names as early as possible.— J. C. ARTHUR, *La Fayette, Ind.*

Monomialism.

I like the tone of the editorial in the May GAZETTE upon nomenclature. The propagators of this new fashion of naming plants are so confident of suceess and have so often predicted that the whole botanical world must make unconditional surrender, that I hasten to express my own feeling in the matter before my guns are spiked and my arms confiscated.

I suppose that the object of a name is to afford some ready and tolerably permanent means of designating a particular plant. And we have always been taught that it is no part of any system of nomenclature to give credit to any person. An author's name is attached to any plant for the simple purpose of identifying the plant name and we are also taught that the oldest name of any plant must stand. In order to meet these various requirements, botanists have been in the habit—erroneously, it now turns out—of employing two words to designate the plant, and this has been known as the binomial system of nomenclature. But now they are telling us that these two words do not constitute *the name* of the plant, but that *the name, per se,* is the second word of the two. In other words, *saccharinum* is the name of the sugar maple, *Canadensis* is the name of a Cornus—although one of my botanies declares that it is the name of a rush and even of a spruce!—and that *repens* is the name of white clover. This is the monomial system of nomenclature, and its devotees are delving through every author in the hope of finding *the name* of the plant. When this name is found—or supposed to be found, which amounts to the same thing—it is attached to some generic name to which it was never designed to fit, and the twain, to which an algebraic formula has been attached, is given to the world as the monomio-binomial name of the plant.

Now there is only one reason why I object to all this, and that is that it serves no purpose. It adds nothing to the stability of the name

but rather weakens it. In many cases we can hardly hope to find the oldest specific name which chanced to be applied to the plant, and we can seldom be sure that we have found it, while it is a comparatively easy and sure process to find the oldest binomial. I deny the proposition that the specific name is *the name.* It does not designate the plant and therefore fails to satisfy the first demand of a name. The binomial answers every requirement of the definition of a name, and it has the distinct advantage of dating from a definite point,—the work of Linnæus. But if we once begin to attach the oldest specific name to any genus whatever — as the fashion of the time may determine — there is no reason why we should stop our search for specific names with the time of Linnæus. In fact, some botanists are even now advising the use of names from the old herbalists, and the system, if logically prosecuted, must eventually include them. I cannot see one point in favor of the new system. It certainly weakens the permanence of nomenclature, for there is less reason to suppose that the mono-binomial is permanent than that the most recent binomial is. After fifty years or so of this upheaval we would be practically just where we are now, except that we should have added cumbersome formulas to nearly all our names. The new mongrel binomials would be subjected to just the same chances as those we now employ. We would have digged a hole for the extreme satisfaction of filling it up again.

The straits into which this new system often leads one are ludicrous. But I object to the untruthfulness of it, in many cases. Carex affords many examples. Tuckerman in 1843 designated a plant, which he took to be a form of *Carex scoparia,* as var. *moniliformis,* and another one thought to belong to *C. straminea* as var. *moniliformis.* Subsequently, Olney determinined that the latter is a distinct species and called it *Carex silicea.* Shall we now overturn the oldest specific name (silicea)— as is done in the Catalogue of Plants of New Jersey — and make an old varietal name a specific one? Shall we make Tuckerman say that he was mistaken and compel him, even indirectly, to raise his variety into a species? *Carex moniliformis* is not Tuckerman's. It is Britton's, and dates from 1889. Olney's name dates from 1868, and I see no other way than to make Britton's name a synonym of Olney's, as we have always done with recent names for all species. And if the var. *moniliformis* of *C. scoparia* should be erected into a species—what then?

They tell me that if botanists had always followed the methods of zoologists, using the oldest specific name in whatever genus, we should have been all right now. But as we did not start in this way, I do not see the force of the statement.

One of the most mischievous features of the whole thing is the ease with which authors of local floras obtain a cheap notoriety by making new combinations—which will likely be changed by the next cataloguer — and the extent to which it fosters the notion that making a new name and differing from an authority are the chief ends of systematic botany.—L. H. BAILEY, *Cornell University.*

NOTES AND NEWS.

DR. RICHARD SCHOMBURGK, director of the Botanic Gardens at Adelade, South Australia, died March 24, aged 80 years.

CORRECTION.—The name of J. N. ROSE should be inserted as joint author with J. M. Coulter of the new species, *Coursetia axillaris*, published last month, p. 180.

VON KLINGGRAEFF has observed Drosera Anglica in west Prussia catching butterflies—Papilio Daplidice and P. Rapae—through the co-operation of several leaves.

DR. GEORGE MACLOSKIE, of Princeton college, has charge of the biological work at "The Seaside Assembly," at Avon-by-the-sea, N. J., during this summer. The work extends from July 5th to August 28th.

AN EXPEDITION has been organized to study Mt. Orizaba, Mexico, during the present summer. Mr. Henry E. Seaton will act as botanist and make a study of the flora in relation to altitude and other conditions.

PROFESSOR JOHN M. COULTER will spend much of the summer along the Mexican border studying the *Cactaceæ*. The work is under the direction of the Department of Agriculture. Messrs. Walter H. Evans and G. C. Nealley will act as assistants.

REV. F. D. KELSEY, of Helena, Montana, has been endeavoring to stir up the spirit of botany in his state by delivering courses of lectures in the different colleges. During the last year he has delivered these courses at Wesleyan College, Helena, and College of Montana, at Deer Lodge.

WITH THE beginning of the second volume, *Zoe*, the biological journal of the Pacific coast, becomes a quarterly, and several biologists are associated with Mr. Brandegee as editors. We fear that the publication of the numbers at so long intervals will be disadvantageous. The April number has a lithograph portrait of Dr. H. W. Harkness as a frontispiece.

A DIRECTORY of European botanists has just been issued by Wilhelm Engelmann, of Leipzig, under the title *Botanisches Adressbuch*, which will be of much service to correspondents. A new edition of Cassino's International Scientists' Directory is being prepared, and will be issued early the coming year. Such works are of value in proportion to their completeness and accuracy, and every person owes it to his fellow workers to see that his own address is properly inserted.

ERRATA.—The following corrections should be made in Mr. Hitchcock's article on West Indian plants. Page 137, line 3 from bottom and p. 138, line 3, for sap read *sop;* line 20, for savory, *curry;* fotnote 24, for Rollinia Sieberi, *Anona squamosa;* footnote 26, for Anona squamosa, *A. muricata;* p. 138, line 12, for mashed, *washed;* line 4 from bottom, for ocara, *ochra;* footnote 42, for Abelmoschus moschatus, *A. esculentus;* footnote 41, for Lechium, *Sechium;* p. 140, line 2, for pie, *pea;* line 5, for roots, *nuts;* line 15, for Lucca, *Lucea.*

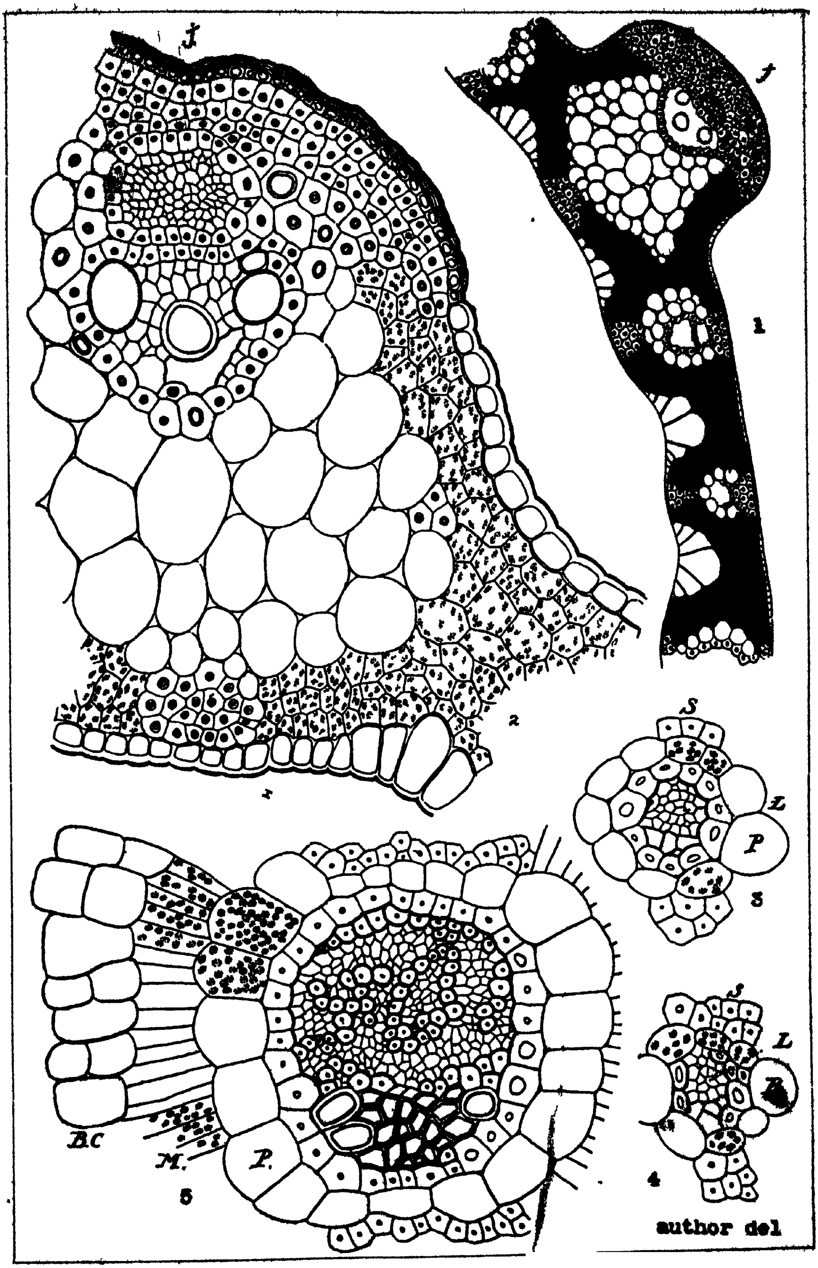
A NEW journal devoted to plant diseases, entitled *Zeitschrift für Pflanzenkrankheiten* has made its appearance under the editorship of Dr. Paul Sorauer, and with the assistance of many able investigators, including Prof. Farlow, Prof. Humphrey and Mr. Galloway, of this country. The price is M. 15 ($3.75) a year. The editor is the author of the largest and best treatise on plant diseases yet published, and the foremost investigator in this line of study. The journal will undoubtedly prove specially acceptable and serviceable to a large circle of investigators.

THE CALIFORNIA Botanical Club was organized March 7th. In response to a call from Dr. H. W. Harkness and others a meeting was held in the herbarium room of the California Academy of Science at which the objects of the proposed club were set forth. May 2nd the charter roll of members was declared closed with 99 names. The list includes a considerable number of the more prominent botanists about San Francisco, but a few names are conspicuous by their absence. The club is to meet on the first and third Saturdays of each month at the rooms of the California Academy.

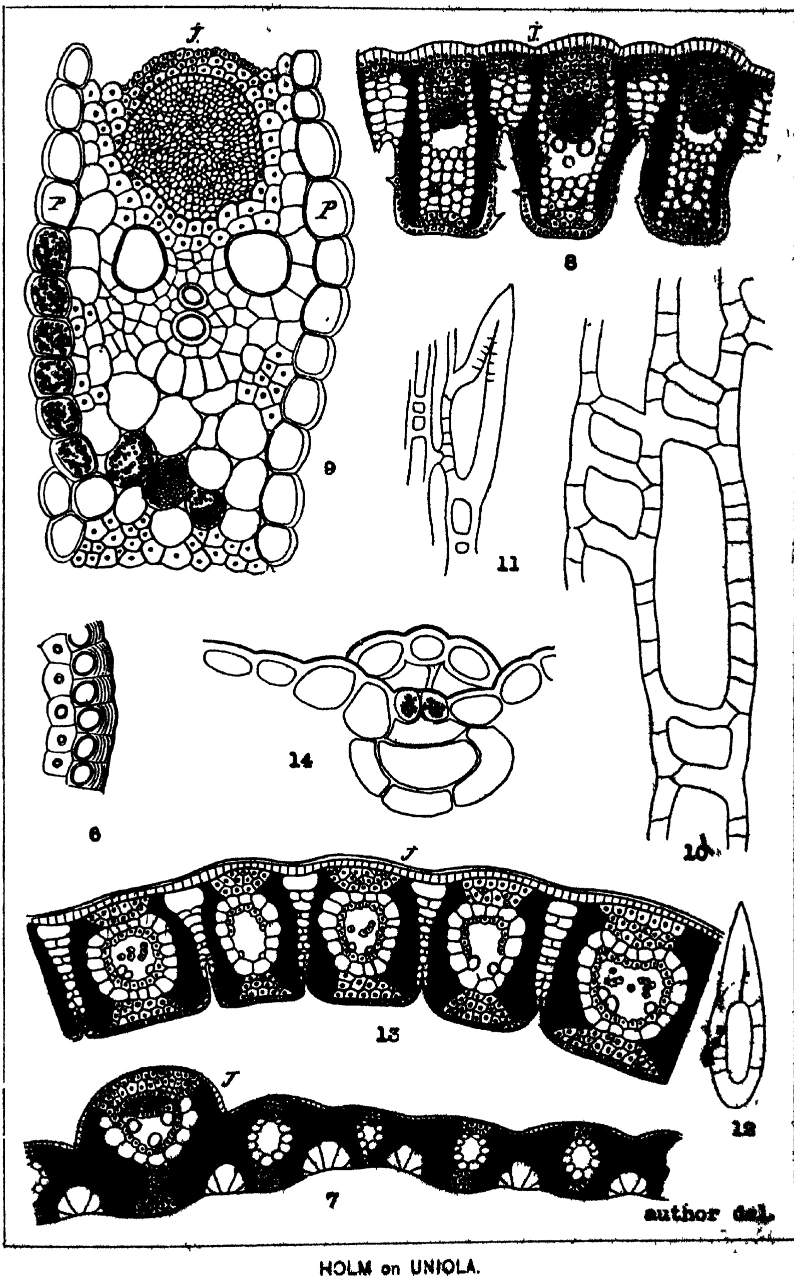
MISS ROSINE MASSON died in Lausanne, May 6th, aged 83 years. The deceased had attained a wide reputation in Europe and was known in this country by her extensive collections and distributing of alpine plants, principally collected by herself even to her very last days. The specimens distributed by her showed great care in preparation and identification. Besides rendering valuable contributions to the knowledge of the flora of Switzerland, she deserves much credit for the assistance she has given to the study of botany by her magnificent collections, deposited in several of the most prominent scientific institutions.—T. H

A SHORT communication in the *Centralblatt fur Bakteriologie* (ix, 557) gives the comparative results arrived at by Dr. George Canera in studying the various forms of swine epidemic, known under the names of hog-cholera, swine-plague, swine-pest, etc. The germs were obtained from about a dozen of the most prominent investigators, and were uniformly grown upon and in various media, and their behavior carefully compared The germs were found to belong to several different species, and to fall into three well marked classes, dependent upon their movement and other characters. Billings' swine-plague and Salmon's hog-cholera germs are said to be specifically different.

ANOTHER revolution has taken place in the matter of postage on botanical specimens. The act of Congress, approved July 24, 1888, fixed the postage on "seeds, cuttings, roots, scions and plants . . at the rate of one cent for each two ounces or fraction thereof." But the May Postal Guide contains a ruling by the Third Assistant Postmaster-General by which *dried* plants and *cut flowers* are specifically excluded from the provisions of this act and declared subject to the cent per ounce rate! By what legerdemain of logic this conclusion was reached the official document fails to state; but until more common sense or a specific act of Congress supervenes botanists will have to double the postage on their packages.



HOLM on UNIOLA.



HOLM on UNIOLA.

A study of some anatomical characters of North American Gramineæ. II.

THEO. HOLM.

The genus Uniola.

(WITH PLATES XXI AND XXII)

Uniola gracilis Michx., *U. nitida* Baldw., *U. paniculata* L. and *U. Palmeri* Vasey.—These four species form together two groups, the first two on the one and the last two on the other side, on account of differences in the anatomical structure of their leaves. It was also to be supposed so, since they inhabit localities so very different. The first group occurs in the woods or swamps, while the second one grows on the sand hills on the sea shore. We shall now see how they differ from each other and from the species described in the preceding part of this paper, U. latifolia, an inhabitant of shaded slopes.

Epidermis.—The epidermis in U. gracilis and U. nitida agrees in most respects with that of U. latifolia, and the only essential difference consists in the presence or absence of long hairs and thorn-shaped expansions; U. gracilis shows the presence of both organs on the superior face of the blade, but in smaller number than observed in U. latifolia. In U. nitida these organs are entirely wanting.

The cells of epidermis which cover the stereome on the inferior face are strongly thickened and laminated in U. gracilis and U. nitida (plate XXII, fig. 6), which shows a difference from what we have seen in U. latifolia. The bulliform cells and the stomates show, however, nearly the same structure and distribution. But in U. paniculata and U. Palmeri the epidermis is entirely different; the cells on both faces are strongly thick-walled and porose (plate XXII, fig. 10), rectangular or quadrangular, and arranged so that there is either one short cell between two long ones, as in U. Palmeri, or even three short between two long ones, as has been observed in U. paniculata.

No hairs are present in these two species, but numerous sharply pointed and porose spines (plate XXII, figs. 11–12) proceed from the superior face of the leaf of U. paniculata,

while in U. Palmeri the epidermal expansions are merely represented by wart-shaped, obtuse organs. The epidermis of the inferior face is on the contrary entirely smooth in these two species.

Stomates are present on both faces, but especially on the margins of the deep sinuses of the superior face, in the strata which border on the bulliform cells; these stomates show in U. paniculata the normal aspect, but in U. Palmeri they are slightly depressed below the general surface (plate XXII, fig. 14), and surmounted by wart-shaped expansions from the epidermis in groups of as many as seven. The bulliform cells of U. gracilis and U. nitida agree very well with those described for U. latifolia; in U. paniculata and U. Palmeri they form only very small groups, but are here in contact with a large mass of uncolored parenchyma.

Mestome-bundles.—The arrangement of these is easily to be seen, if the sections figured in the accompanying plates are examined. Plate XXI, fig. 1 shows a section of the median part of the blade of U. gracilis; plate XXII, fig. 7, a similar section of U. nitida; fig. 8 of U. paniculata; and fig. 13 of the female plant of U. Palmeri. It must be remarked here that the anatomical structure of the leaf of the male and female plant of U. Palmeri is identical.

The carene in U. gracilis and U. nitida is occupied with but a single mestome-bundle, whereas there were several in U. latifolia. In U. paniculata and U. Palmeri there is no carene and the median nerve is not different in any respect from the largest ones in the whole blade. Furthermore there are no mestome-bundles between the groups of bulliform cells and the epidermis of the inferior face, as was the case in U. latifolia.

The minute structure of the mestome-bundles in U. gracilis and U. nitida is the same. There is a thin-walled parenchyma-sheath around the entire bundle, uncolored in the midrib or partly green in the other ribs. Sometimes, as for instance in the large bundles excepting the median one, the parenchyma-sheath has a few thick-walled cells, where it is in contact with the stereome. But besides this, the proper sheath is also to be seen and inside this another one, which consists of very thick-walled cells, forming in the largest bundles, those of first degree, a closed sheath around the leptome and the hadrome. This inner sheath is also present in the smaller bundles, but is here more or less interrupted

(plate XXI, fig. 4). In U. latifolia there is present a thick-walled parenchymatic tissue between the leptome and hadrome, and the same is also to be observed in U. gracilis and U. nitida, at least in the largest bundles. But neither this stratum nor the inner sheath of thick-walled cells may be considered as indicating any mestome-sheath; they merely represent a mestome-parenchyma for the same reason as mentioned for U. latifolia.

The mestome-bundles show, as in U. latifolia, three different forms depending on their strength and development. Those of the first degree have a closed inner sheath besides a layer of similar thick-walled cells between the leptome and hadrome, while in those of the second degree the leptome and hadrome are in contact with each other. In the smallest bundles there is no closed inner sheath of thick-walled cells, but merely an interrupted layer on the leptome side, and the leptome and hadrome are in immediate contact with each other. The leptome and hadrome, considered by themselves, show the strongest development in the largest bundles, those of the first degree.

As to the distribution of these different forms of mestome-bundles in the entire blade, I do not dare try to give any formula, as has been done in U. latifolia. There seem to be too many variations, especially on comparing leaves of specimens from different localities, but it may be said with good reason that the bundles of the second degree are the most numerous in the whole blade, while the largest ones are present in a relatively small number.

On examining the mestome-bundles in U. paniculata and U. Palmeri, there will be seen a rather important difference in structure from what has been shown above. The proper parenchyma-sheath is thin-walled in both species, but contains large deposits of starch in U. paniculata (plate XXII, fig. 9) and forms a border between the entire mestome-bundle and the mesophyll on both sides. In U. Palmeri (plate XXII, fig. 5) on the contrary it does not contain starch and forms an annular sheath around the whole bundle, not extending to the epidermis on either of the two faces.

There is in the largest bundles of U. paniculata a closed sheath of thick-walled parenchyma around the leptome, while in U. Palmeri both the leptome and hadrome are surrounded by a similar sheath, besides which the leptome contains several groups, more or less isolated, of very thick-walled cells.

Although not strictly belonging to the mestome-bundles, it may be mentioned here, that there is in the U. paniculata a quite considerable tissue of large-celled parenchyma between the hadrome and the stereome of the superior face, and this parenchyma contains starch, like the surrounding sheath.

We shall also find in these two species a certain difference as to the development of the mestome-bundles, as described for the preceding species. U. paniculata shows two degrees, the first one as described above; the second is on the contrary characterized by having the leptome and hadrome in contact with each other. U. Palmeri shows, besides the form of the first degree described above, a second one, in which the inner sheath is reduced to a horse-shoe shaped layer on the leptome side, besides a few thick-walled cells between the leptome and hadrome but none in the leptome itself.

These layers of thick-walled cells in the mestome-bundles of U. paniculata and U. Palmeri, whether they form a closed sheath or not, are identical with those mentioned for the preceding three species, as representing a mestome-parenchyma; the same is the case with the groups of similar cells, which we have seen in the leptome of U. Palmeri. Concerning the distribution of these different mestome-bundles in the U. paniculata and U. Palmeri, those of the second degree are the most numerous, but no rule can be given as to their situation between the larger ones.

The stereome.—This forms in U. gracilis and U. nitida two groups, one above and one below each mestome-bundle, and shows only very small differences. In U. gracilis the stereome of the superior face of the carene is widely separated from the mestome-bundle by a large tissue of uncolored parenchyma, while in U. nitida it borders immediately on the parenchyma-sheath. It forms as in U. latifolia a nearly triangular group on each margin of the blade. Nearly the same arrangement is found in U. paniculata, in which there is one group above and below each mestome-bundle. In this the stereome of the superior face is widely separated from the mestome-bundle by the parenchyma, which has been described above. Small groups of stereome are also to be observed inside the proper parenchyma-sheath of this species (plate XXII, fig. 9); it seems as if these thick-walled cells belong to this element, the stereome, rather than to the hadrome.

Finally U. paniculata shows groups of stereome opposite the bulliform cells, separated from these by an uncolored tis-

sue of parenchyma. U. Palmeri has not these last mentioned stereome-groups opposite the bulliform cells, but merely one above and one below each mestome-bundle, both of them bordering on the parenchyma-sheath.

Besides these groups of stereome, there is also one large group on each of the two margins of the blade of both U. paniculata and U. Palmeri.

The mesophyll.—This tissue is most extensive in U. gracilis and U. nitida, where it forms broad layers of rather large cells between the mestome-bundles and is in contact with epidermis on both faces. It is relatively but sparingly represented in the two other species, and is here not only separated by the mestome-bundles with their corresponding groups of stereome, but also by the broad layers of uncolored parenchyma. Thus there is one two isolated group of mesophyll on each side of the mestome-bundles. The cells of this tissue are, in U. paniculata and U. Palmeri, rectangular, very narrow and thin-walled.

The uncolored parenchyma.—This is very distinct in the carene of U. gracilis (plate XXI, fig. 2), where it occupies a large space between the mestome-bundle and the superior epidermis. There is also in this same species a single stratum of uncolored cells outside the parenchyma-sheath of the two mestome-bundles next to the midrib and bordering on the carene (plate XXI, fig. 1). This parenchyma is also present and relatively much more abundant in U. paniculata and U. Palmeri, where it forms large groups between the bulliform cells and the epidermis of the inferior face.

From the foregoing it will be seen that these five species of the genus Uniola show several anatomical characters in their leaf-structure by which they may easily be distinguished. These characters may be summarized as follows:

Epidermis

Large cells in alternation with small ones	U paniculata. U Palmeri
Long hairs on the superior face	U. latifolia U gracilis
Thorn shaped expansions on the superior face..............	U latifolia. U gracilis U paniculata
Wart-shaped expansions on the superior face	U Palmeri
Bulliform cells forming large groups	U latifolia U. gracilis. U nitida.

Bulliform cells forming smaller groups	U. paniculata. U. Palmeri.
Stomates depressed, surmounted by epidermal expansions	U. Palmeri.

Mestome-bundles.

One buudle between each group of bulliform cells and the inferior epidermis	U. latifolia.
Leptome and hadrome surrounded by a sheath of thick-walled parenchyma in the large bundles	U. gracilis. U. nitida. U. Palmeri.
Only the leptome surrounded by thick-walled cells	U. latifolia. U. paniculata.
Groups of thick-walled parenchyma in the leptome	U. Palmeri.
Parenchyma-sheath containing starch, extending from the superior to the inferior epidermis, not forming any annular sheath around the bundle	U. paniculata.

Mesophyll.

Separated by groups of uncolored parenchyma	U. paniculata. U. Palmeri.

Stereome.

Six isolated groups on the superior face of the carene	U. latifolia.
One group opposite the bulliform cells	U. paniculata.
Isolated groups inside the parenchyma-sheath	U paniculata.

Uncolored parenchyma.

One large group in the carene	U. latifolia. U gracilis.
One group between the mestome bundles	U. paniculata. U. Palmeri

U. S. National Museum, Washington, D. C.

EXPLANATION OF PLATES.

PLATE XXI.—Figs. 1–4. *Uniola gracilis.*—Fig. 1. Transverse section of leaf. × 37.—Fig. 2. Transverse section of the median part of the leaf, the carene; the inferior face of the leaf at *I.* × 160.—Figs. 3 and 4. Transverse sections of two small mestome-bundles. Fig 3 shows a closed sheath of thick-walled parenchyma-cells inside the proper parenchyma-sheath *P. L*, the leptome: *S*, the stereome on the inferior face of the leaf In fig. 4 the inner sheath is not complete, but merely represented by two groups of thick-walled cells. × 200.

Fig. 5. *U. Palmeri.* Transverse section of a large mestome-bundle. On the left side in the figure are the bulliform cells to be seen at *B*, *C*, and the mesophyll at *M.* Several thick-walled parenchyma cells are to be observed in the leptome and there is a closed sheath of similar cells inside the proper parenchyma-sheath *P.* × 320.

PLATE XXII.—Fig. 6. *U. gracilis.* Epidermis, taken from the carene, transverse section. × 560.

Fig. 7. *U. nitida.* Transverse section of leaf; the inferior face at *I.* × 74.

Figs. 8–12. *U. paniculata.*—Fig. 8. Transverse section of leaf; the inferior face at *I*, × 60. Fig. 9. Transverse section of a large mestome-bundle. The proper parenchyma-sheath, *P*, contains starch, figured in a few of the cells, as

does also the large parenchyma cells between the mestome and the stereome of the superior face The leptome is enclosed by layers of very narrow cells and separated from the hadrome × 240 Fig 10 Epidermis of the inferior face. × 560 Figs 11 and 12. Thorn-shaped expansions from the superior epidermis, seen from the side and from above × 240.

Figs 13 and 14 *U. Palmeri* —Fig 13 Transverse section of leaf × 74 Fig 14 Stomate from the inferior face, transverse section × 320

Notes on Uredineæ.

J. C. ARTHUR.

Puccinia Stipæ is variously cited by different writers. Dietel[1] writes *P. Stipæ* Opiz, and considers the American form, heretofore called *P. Stipæ* Arthur, identical with it. In Sydow's Uredineen, fascicle I, No. 28, it is given as *P. Stipæ* (Opiz) Hora, and is so spoken of by Magnus[2] in a notice of the publication.

Opiz[3] made use of the name in a list of Bohemian plants, in which no characterizations or notes of any kind are given. It was not used as a specific name, but for a sub-form of a variety of P. Graminis. The full name reads *Puccinia Graminis* Pers., c *foliorum* Opiz, *β Stipæ* Opiz. The host is not mentioned, but it was presumably a Stipa, and quite possibly S. capillata, on which the rust was gathered in 1888 by Paul Hora in the region covered by Opiz's list. Whether a description of the species has been published by Hora or not the writer does not know, but if so it probably did not antedate the publication in America.[4] The name correctly written would therefore be *Puccinia Stipæ* (Opiz) Arthur.

Puccinia ornata was first published as the name of a Leptopuccinia on Rumex[5] in 1887, and consequently the later application of the specific name to another Puccinia by Harkness[6] calls for correction. It would be a pleasure to dedicate this interesting form to the discoverer, if another

---

[1] Hedwigia, xxviii, (1889, p 187)
[2] Hedwigia, xxviii, (1889, p 94).
[3] Seznam Rostlin Kvetêny Ceské, 1852, p 138
[4] Arthur, Preliminary List of Iowa Uredineæ, in Bull Iowa Agric Coll, Nov. 1884, p 160
[5] Report of botanical work in Minnesota, in Bull No 3, Geol Surv Minn, 1887, p 30.
[6] Proc. Cal. Acad Sci., 2nd Ser, ii 1889

species of the genus did not already bear his name. The name **Puccinia medusæoides** is therefore proposed for it, from the resemblance of the branched pedicel of the teleutospores to that of Spegazzini's *P. Medusa*.

Uromyces perigynius has an error in the description as originally published in Journal of Mycology, v. p. 11, to which my attention has been directed by Mr. E. W. D. Holway. The measurements of the teleutospores, as there given, should be multiplied by three, making the true dimensions 12–18× 24–30μ.

The teleutospores found upon the leaves do not, as a rule, have the apex long and pointed, but more or less rounded, and the spore correspondingly shorter.

Dietel[7] demonstrated that *Uromyces Caricis* Peck, is the uredo of a Puccinia, which he called *P. Caricis-strictæ* D., and remarked that no true Uromyces upon Carex is known. A month afterward *U. perigynius* Halst. was published, and it appears to be a true Uromyces. No mention in the original description is made of the uredo form, but I have received from Mr. E. W. D. Holway excellent material collected in August, 1887, upon the leaves of *Carex pubescens*, bearing both uredo- and teleutosori. The uredospores are globose, epispore thin and echinulate, 15–18μ in diameter, with occasionally a spore measuring 22–28μ. The uredospores possess two or three lateral germ-pores, while the teleutospores have a single terminal germ-pore. This pore is not easily demonstrated in most cases, even with the use of sulphuric acid. Any doubt of its presence, however, is put to rest by a specimen collected by the writer, in Indiana, upon a Carex that is probably C. pubescens. It was found in May upon the leaves of the preceding season's growth. Most of the teleutospores in this specimen have the terminal pore distinctly open, from having already germinated without dropping out of the sorus.

Coleosporium Viburni was established upon the uredo form alone. Teleutospores have since been gathered upon the same host, *V. Lentago*, at Racine, Wis., by J. J. Davis. The sori are hypophyllous, scattered, yellow; teleutospores cylindrical, or elongated clavate, three- or four-locular, smooth, 20–30×65–90μ.

Puccinia Cyperi n. sp.—Sori irregularly scattered upon effused brown spots on the culms and under surface of foliage

---

[7] Hedwigia, xxviii (1889), p. 22.

and involucral leaves, oblong, long covered with thick epidermis; uredospores elliptical or nearly round to obovate, epispore thin, echinulate, 19–22 × 20–30μ; teleutospores brown above and pale below, elongated oblong, little if any constricted, vertex strongly thickened, obtusely and obliquely pointed, epispore thin, smooth, 17–20 × 33 × 63μ; pedicel short, one-third the length of the spore or less, slightly colored.

On *Cyperus Schweinitzii:* Iowa, E. W. D. Holway, J. C. Arthur; Nebraska, H. J. Webber, in *Flora of Nebraska*, No. 369; Wisconsin, W. Trelease and L. H. Pammel, in *Paras. Fungi of Wis.*, No. 202. On *Cyperus strigosus:* Michigan, J. C. Arthur.

This species is related to *P. obtecta*, and in the form of its teleutospores also resembles *P. Caricis*, to which it has been referred.

Uromyces Gentianæ n. sp.—Sori scattered over the green parts of the host, oblong or round, soon naked, brownish-yellow color; uredospores globose or ovoid, epispore thin, echinulate, 18–20 × 19–25μ; teleutospores globose or ovoid, yellowish-brown, vertex rounded, slightly thickened, epispore thin, obscurely papillate, 15–19 × 19–23μ, pedicel fragile, very short.

On *Gentiana quinquefolia* var. *occidentalis*, Decorah, Iowa, E. W. D. Holway.

The teleutospores are almost the same size and color as the uredospores, and quite different from the one-celled teleutospores of *Puccinia Gentianæ*. That these are genuine teleutospores is certain from the presence of a terminal pore, which shows very distinctly upon using sulphuric acid. Their close resemblance to the uredospore has caused them to be overlooked heretofore. The uredospores are sometimes thickened like the teleutospores, but the spot is always lateral, and not terminal, and by using acid the two or three lateral pores can be made visible.

Purdue University, Lafayette, Ind.

A sketch of the flora of Orono, Me.

F. LAMSON-SCRIBNER.

[The writer desires to have the facts embodied in the following paper, prepared in 1872 and hitherto unpublished, placed on record for the use of those who may hereafter compile the flora of Maine]

An account of the flora of any region is valuable as indicating the local distribution of plants—a matter of much interest to the botanist and agriculturist. The geographical range of species is thus established. A knowledge of the plants of a locality enables one to form a very correct opinion of its climate and the nature and condition of the soil. On the other hand, the climate and physical features of a locality form an index to the variety and nature of the plants which may there be found. The extreme northeastern position of this locality renders it of more than ordinary interest.

The physical characters of this region are such as to afford a large number of species, and I very much regret that the list here presented is a so meager. It is to be hoped that the work thus begun will be rapidly advanced by the students of the College, in order that we may soon possess a complete list of the Phanerogams and Vascular Cryptogams of this entire region. The Mosses and Lichens have not yet been worked up. Of these lower, yet vastly interesting families this section certainly presents a rich field. Future researches will not only add much to our knowledge of those species already observed, but largely increase the list now made.

Almost every variety and condition of soil found in our latitude—except that of the seashore and high mountains—is to be met with here. The Stillwater branch of the Penobscot river flows close by the College front, and a mile in the opposite direction flow the rapid waters of the main river. Species delighting in sandy and rocky river banks find along these waters congenial homes. There are extensive meadows and upland glades; numerous streams of varied character; deep sphagnous and grassy swamps of larch, spruce and cedar. There are high rocky deciduous woods; steep gravelly hills and sandy fields; several ponds or lakes with both sandy and muddy shores, and an almost unlimited extent of mossy bog-land.

With all these varied conditions one may reasonably expect an extensive and interesting flora. Only a small portion of this territory has been thoroughly examined, and no

one locality visited throughout the entire season. The blooms of the month of August have been but partially observed, that being the month of the summer vacation. It has been my good fortune to examine the floras of Manchester and Waterville of this State; as compared with these the region of Orono and vicinity is much more interesting botanically, being peculiarly rich in rare and local species. Several localities, visited but once or twice, have appeared very interesting, and may, when more thoroughly explored, yield many rare and pleasing species.

Such a locality is the one near Pushaw mills, on the river about two miles above Stillwater village. This place was visited in June, last season, and we were rewarded by finding several species new to our list, one of rare interest. The water at this place rushes rapidly over a rocky bed, and the west bank is formed by a high precipitous cliff, on which specimens of the Sand Cherry (Prunus pumila L.) were found. This, our smallest species of the cherry tribe, is a little trailing shrub growing over the sand and rocks, rarely attaining the height of sixteen inches. Growing in abundance close by the bank were Aquilegia Canadensis L., Potentilla tridentata Ait., and the small purple Houstonia (H. purpurea L., var. longifolia Willd.). Out from the perpendicular walls of the cliff there was growing a pretty little fern, which was too immature for identification. But the chief interest of this locality is that it produces Arabis Drummondii Gray, the upright slender stems standing out from the bare rock walls, wherever there is a possibility for its fibrous roots to penetrate and find foot-hold. This is a rare, and, on account of its pale glaucous leaves and rose white flowers, a very attractive Crucifer. Although uncommon, this species has a wide geographical range, extending from Maine to Oregon. Astragalus alpinus L., an exceedingly pretty leguminous plant which grows on a small rocky island in the Kennebec river opposite Waterville, may be looked for here. Coming back to the College from the place we have just been describing I found numerous specimens of Carex Houghtonii Torr., growing on the grading of the Orono and Stillwater Railroad near the town bridge at the last named place The Rev. J. Blake has collected this Carex at Medford. Another locality which has been visited but once (July 1870) is Nickol's Stream which flows through an extensive bog and forms the outlet of a pond of the same name in the town of Bradley.

The plants which characterize the place, as observed upon one hasty trip, are Lycopodium inundatum L., Eriophorum alpinum L., Limnanthemum lacunosum Griseb., Carex rostrata Mx., and Spartina cynosuroides Willd. This last species was found just by the outlet of the pond. The Lycopodium is a dwarf species from one to three inches high. It was growing on muddy soil close by the waters of the stream. Last season I found the same species growing on a bog in Manchester. It is quite rare, and valuable for exchanges. The enthusiastic student would be well repaid by a visit to this stream.

An excursion was made to Pushaw Lake in June, 1870, and the following species noted: Lobelia Dortmanna L., Nuphar luteum Smith, var. pumilum, Pontederia cordata L., Brasenia peltata Pursh., Eriocaulon septangulare With. Near the lake, Potentilla palustris Scop. was found in abundance. Along the way to the lake specimens of Smilacina trifolia Desf. and Phalaris arundinacea were collected.

About three miles southwest from Orono village there is a large bog, where are found nearly all the plants common to such localities. The main road from Stillwater to Bangor passes through this, making it easy of access. From here most of the bog plants of the College herbarium were obtained. The last of April or early in May we go to this locality for Symplocarpus fœtidus Salisb., Cassandra calyculata Don, and Andromeda polifolia L. It is here too that we find the Lonicera cœrulea L. and later in the season Arethusa bulbosa L., Calopogon pulchellus R. Br., Pogonia ophioglossoides Nutt. and Habenaria blephariglottis Lindl., four of our prettiest Orchids. The Pitcher Plant (Sarracenia) luxuriates here in the damp Sphagnum, opening its odd flowers with deep purple, fiddle-shaped petals and umbrella-like style, about the middle of June. Among the species of this bog we mention the species of Osmunda and Eriophorum, Menyanthes trifoliata L., Carex pauciflora Lghft., C. chordorhiza Ehrh., C. lacustris Willd., and many other species of Cyperaceæ.

In the woods which lie in a direct line from the College to the bog here spoken of, known as Bennock's woods, there were collected last summer (1873) many specimens of Calypso borealis Salisb., a rare and most beautiful Orchid. In one small spot, not more than 2 feet square, the writer observed nearly one hundred specimens in full bloom! A more pleasing or beautiful sight can hardly be imagined. A few specimens of the Calypso have been found in the swamp east of

the Colleges. It has also been seen in considerable numbers in the woods opposite the "Trotting Park." In Bennock's woods above mentioned, I gathered in 1871 a number of specimens of Botrychium simplex Hitch. In 1870 this plant was observed in the low fields between the house formerly occupied by Prof. Peckham, and the river.

An exceedingly rich and interesting locality, botanically considered, is the region below Basin Mills, extending down by the river and along the railroad for two or three miles. Here we find a great variety in the nature and condition of the soil, producing many species. Upon a high and gravelly bank less than half a mile below the Basin, near John McPheter's brook, grows a rare and elegant vine, Clematis verticillaris DC. It is a more delicate plant and prefers a drier soil than its near relative, C. Virginiana L. It is by far the prettier species, however; in fact it well deserves to stand first, as regards ornament, among our native climbers. The showy bluish purple petals of the flower expand two or three inches. It blooms from the middle to the last of May. The flowers are followed by the rather pretty plumose fruit. It is easily cultivated and is worthy a place among our handsomest foreign vines. By the rocky bank of a railroad cut, perhaps two miles below the mills, we find another beautiful native climber, called Wax-work or Bittersweet, Celastrus scandens. It receives its first name on account of the waxy aspect of the fruit, which in autumn presents a most brilliant appearance. Near where the Bittersweet grows there is found an abundance of the bright Saxifraga Virginiensis. Along by the railroad we find the pretty Corydalis glauca. Near the railroad there is a bog-marsh where delights the Calla palustris. Upon the bog we find Carex irrigua, one of the most attractive of the Carices.

About a mile below the mills there is a slow muddy stream where grows Nuphar advena. In a thicket close by this stream we find rather an uncommon species of Trillium (T. recurvum), which conceals its white or sometimes pinkish flower beneath its trio of leaves. Upon the dry banks near by Pedicularis Canadensis abounds, with its long, finely cut leaves, which are often of a deep purple color, and very handsome. Two miles, or perhaps two and a half miles below the mills, there is a rich marshy spot where in May we are attracted by the bright golden flowers of Caltha palustris. This is also the locality of Thaspium aureum and Archangelica atropurpur-

ea. On the shaded banks near at hand grow the large yellow Viola pubescens and Thalictrum dioicum L. Just below the mills in early spring may be observed the large coarse plaited leaves of Veratrum viride Ait. This locality also contains Nemopanthes Canadensis, Cassandra calyculata, Rhodora Canadensis, Ledum latifolium, Kalmia glauca and K. latifolia.

On the island at Basin Mills Arctostaphylos Uva-ursi Spreng., Houstonia purpurea, var. longifolia Gray, and Oryzopsis Canadensis may be found. Veronica Buxbaumii Tenore was collected on the high bank between Orono village and Basin Mills, just above "Cold Spring."

In a swamp in Bradley on the left hand side of the road going to Nickol's Stream, grows the most showy and beautiful of the Lady's Slippers, Cypripedium spectabile. With this Cypripedium are found Habenaria hyperborea and Listera cordata. The latter delicate and inconspicuous little orchid also abounds in the swamp just east of the College.

We now come to consider a few of the more interesting plants found immediately about the College. The Calypso has already been alluded to as having been observed near here. In the field in the rear of the new barn, specimens of Ophioglossum vulgatum were gathered in 1872. In the clearing in the same direction Nardosmia palmata grows in great abundance. I have observed this plant growing sparingly in Manchester. Dr. Goodale speaks of its being common in swamps near the Canada line on the "Canada Road." It is by no means a rare plant in this neighborhood. In some places it is as abundant as Erechthites on newly burnt land. This plant blooms the first of May, and is quite a puzzle for beginners, not only on account of its Composite character, but because the palmate leaves (whence the specific name) do not appear till late in the season.

Specimens of Aralia quinquefolia have been collected in the woods near the "Trotting Park." Vaccinium Canadensis Kalm abounds just east of the College. It is distinguished by its low growth and pubescent leaves, better known, however, by its rich, sweet berries. The following Orchids are found in the woods back of the College: Habenaria Hookeri Torr., H. orbiculata Torr., Spiranthes cernua Rich., S. gracilis Big., Corallorhiza innata R. Br., C. multiflora Nutt., Goodyera repens R. Br., G. pubescens, R. Br., Listera cordata R. Br., Calypso borealis Salisb., Cypripedium parviflorum Salisb.' C. acaule Ait

The kinds of trees composing these woods are hemlock, fir, spruce, poplar, pine, maple, birch, beech, etc. The woods about the College are thus of a mixed growth, coniferous trees and soft wood predominating. The forests west and north on rocky uplands have more hard wood species. The forests are all second growth and none of the trees are of large size. Hard woods suitable for lumbering purposes are very scarce. The same is true of pine. The sugar maple occurs, but not in sufficient abundance to make sugar-making a paying business.

Acer dasycarpum Ehrh. grows along the banks of the river between Stillwater and Orono villages. It is a tree of large growth and often maintains a majestic, if not a magnificent appearance. It is distinguished from A. rubrum L. by the silvery whiteness of the under surface of the leaves, whence the trivial name. The branches are large and gradually expanding as they ascend, often becoming recurved somewhat in the manner of the elm. The wood is soft and fine grained, of moderate strength and perishable.

By the river in front of the College we find Viola lanceolata and Ranunculus Flammula, var. reptans. Potentilla palustris and Campanula aparinoides are found in the meadow below the farm house. On the side of the river opposite from the farm house there grow two very attractive vines, Calystegia sepium and Apios tuberosa. During the past season there was found along this bank the noble Ostrich Fern (Struthiopteris Germanica Willd.).

The variety of grasses upon the farm are those of common occurrence though there is a greater predominance of the better sorts. The bits of swale land, which are few, contain the ordinary sedges and species of Glyceria. The chief grasses which form the hay crop are timothy and red top with occasional plants of brown top or fowl meadow grass. With this hay there is mixed a small proportion of several kinds of clover. The forage plants which have been introduced by the present farm Superintendent are Hungarian millet and Alsike clover.

There are but few weeds found in Maine which have not been observed growing upon the College premises. Last season there was detected in a grain field a weed which the writer at least had not before observed, viz.: Camelina sativa Crantz. Darlington says this plant was introduced with flax, and remains as weed where the culture of that plant has been

abandoned. There is much danger of new weeds being introduced with the seeds or roots of plants received upon the farm from the Patent Office and elsewhere. Those weeds which give the most trouble are barn grass, rag-weed, purslane and couch or witch grass. The number of species in the College herbarium is 316, representing 66 orders. This does not include several species undetermined, nor the Compositæ, Salices, Juncaceæ, Cyperaceæ, and Gramineæ, and only a portion of the higher Cryptogams. The actual number of species observed, aside from the families mentioned, is 455.

Orono, Maine, 1872.

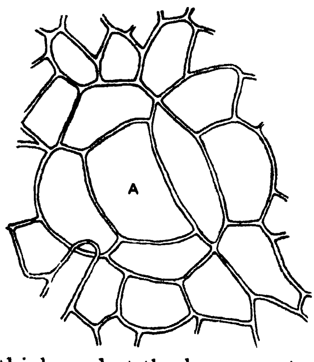
BRIEFER ARTICLES.

Notes on the pollination of Helianthus.—Having had growing in my room for some months a specimen of Helianthus annuus, I have observed its habits closely to see if I could find something new or interesting. Nothing out of the ordinary was observed until it came to bloom, which it did in March, bearing a single head. During this period I observed it very closely, from the time of the opening of the first disk floret until the last had withered away. Most of the flowers behaved in the usual way, the style pushing out the pollen from the stamen tubes and cross-fertilization was insured by protandry. But in a number I noticed movements, to me quite new and interesting.

The styles in these cases appeared as usual and soon spread their tips for the reception of pollen. After standing in this way for about two days I was greatly surprised to see that they were being drawn back into the stamen tube. This they continued to do until they finally disappeared. Then the stems were forced to one side and from between the filaments were seen the bent styles slowly backing out, resembling very much the extraction of the plumule from the acorn in germination. This it continued to do until the entire style was withdrawn, leaving the stamens wilted and collapsed lying upon the limb of the corolla. Then the style assumed an erect position, spread its tips and apparently stood waiting to receive pollen. This entire act was accomplished in about a dozen cases; failed to more than draw back into the stamen tube in about as many more; and in two the style was broken in attempting to escape. All this was observed only in the outer circle of tubular flowers, which preceded the others by about four days.

The reason for this I attribute to the attempt of the flowers to secure pollination. The plant was kept in a room, and while the flowers were few in number there was no chance for the transfer of pollen, as was easily the case when they became more numerous and crowded. The stamens appeared to wilt in about two days after their pollen had been thrust out by the styles and had they, as was observed in later cases, drawn the styles down into the tube with them, then the object of their living would have been defeated. In two cases I transferred pollen to the stigmas and no movement of the styles was noticed independent of the stamens, but after a time both styles and stamens were drawn down within the tube. My conclusion is that undoubtedly the first cases failed of fertilization and the withdrawing of the styles and the subsequent unfolding of the style branches was a plan to longer present their stigmas for the reception of pollen.—WALTER H. EVANS, *Herbarium Eli Lilly & Co., Indianapolis.*

An abnormal water-pore.—The accompanying figure illustrates a curious water-pore found by Mr. E. L. Hicks, a student in the botanical laboratory of the University of Wisconsin, while examining these structures on the leaves of *Tropæolum majus.* The four guard cells bound a somewhat trapezoidal pore, *A*. The whole apparatus reminds one strikingly of a stoma of *Marchantia polymorpha.* That it was a functionally active pore was shown by the distinct incrustation of the guard-cells with mineral salts.—C. R. B.



A new grass: Melica? multinervosa.—Culms from a strong creeping rhizoma, about 3 ft. high, somewhat thickened at the base, erect, smooth, frequently geniculate below, the lower nodes hairy: leaves four or five, narrow, rather rigid, 6 to 12 in. long, becoming involute; lower sheaths much longer than the internodes and open above, upper sheaths shorter; ligule a prominent ring of hairs: panicle erect, 6 inches long, the branches single, the lower ones 3 inches long, flowering above the middle with 3 to 6 single, alternate, short-pedicelled, approximate spikelets, the upper branches gradually shorter, above nearly sessile, the lower branches spreading somewhat in flowering; rachis angular, scabrous, hairy in the main axils: spikelets spindle-shaped or linear-lanceolate, 6 to 9 lines long, 8 to 12-flowered, slightly compressed, the flowers imbricated, purple on the margins; empty glumes somewhat unequal, the lower 2 lines long, 1- or faintly 3-nerved, the upper 7-nerved, both

ovate, acutish, not keeled, coriaceous, smooth; flowering glumes ovate, acutish, slightly thinner than the empty glumes, rounded on the back, about 7-nerved, 2½ to 3 lines long, pubescent on the margins and back below, and thickly pubescent on the rachilla; palet ovate, about 2 lines long, in maturity divided to the base, the two keels winged: stamens 3, included; stigmas 2, plumose; grain concavo-convex, roundish, the 2 thin margins incurved, the 2 thickened styles persistent at the summit.

Collected at Brazos Santiago, Texas, by *G. C. Nealley*, 1891. I place this species doubtfully in Melica, although it differs in several particulars from any species of that genus with which I am acquainted. First, the empty glumes are rather thicker than the flowering ones; second, the upper glume is 7- to 9-nerved; third, the upper flowers of the spikelet are not club-shaped; fourth, the base of the flowering glume and the rachilla are densely pubescent; fifth, the ovary is roundish in outline, concavo-convex with the margins incurved, and 2 thick horn-like styles.—GEORGE VASEY, *Washington, D. C.*

Fasciation in Cnicus lanceolatus.—The most peculiar case of fasciation that ever came under my notice is that of a common thistle

(*Cnicus lanceolatus* Hoffm.) recently obtained from Grand Traverse county, in Michigan. The accompanying cut will give some idea of its shape. The specimen where cut off, a few inches above the ground, is 3¼ inches wide. Its greatest width is 11½ inches, the average width being a little over 7 inches and nowhere more than an inch thick. The plant is 3 ft. 7 in. high including the bending top. It does not branch, but for the most part the broad stem is well covered with leaves. The numerous flower heads are sessile or nearly so at the very summit.—J. W. TOUMEY, *Botanical Laboratory, Mich. Agr'l College.*

A new Eriogynia. Notes.—**Eriogynia** (*Petrophytum*, Nuttall) **Hendersoni** n. sp.—A depressed branched plant more or less pilose; leaves green, very slightly if at all sericeous, half to one inch long, spatulate, somewhat abruptly acute, thick, three-ribbed beneath, those of the scapes very small and few, resembling bracts; inflorescence racemose,

much more open and loose than in *E. cæspitosa* Watson; pedicels three lines long, usually with a small bract midway, but these sometimes basal on the lowest; calyx-lobes oval, obtuse; disk hairy within, about the length of the calyx-tube and adnate to it except the free crenulate edge—the twenty-five or more stamens inserted just outside the margin; carpels five, each two- to four-ovuled, one- or two-seeded, hairy along the inner edge, oblong-obovate to ovate, the rather rigid styles bent outward; filaments filiform or slightly flattened at the base; petals white, smooth, oblong to nearly orbicular, unguiculate, nearly as long as the stamens; seeds linear; scapes three or four inches high.

An interesting plant, nearest to *E. cæspitosa* Watson, differing especially in the smoother, more robust habit, the shorter and proportionally broader carpels, the shorter and stouter styles and the thick, three-nerved leaves. Except the inflorescence the general habit resembles that of Arctostaphylos alpina. It was discovered on vertical cliffs near the summit of the Olympic Mountains, Washington, at an altitude of 7,500 ft., July 15, 1890, by Prof. L. F. Henderson, for whom it is named; and was also collected in the same region on Sept. 30 following, by Mr. Charles V. Piper.

Mr. J. W. Blankinship collected, July 7th, 1890, in the Big Horn Mountains, Wyoming, at an altitude of 10,000 ft. what seems to be good *Erigeron Tweedyana* Canby & Rose.

Prof. E. L. Greene has issued some advance sheets of Pittonia, vol. ii, pp. 159–166, July 1st, 1891. On page 162, a plant is described as new under the name of *Tellima nudicaulis.* This is evidently the same as Nos. 119 and 52b of the collections of the Northern Transcontinental Survey, distributed by me under the MS. name of *Tellima pentandra* and which Prof. D. C. Eaton described as *Heuchera Williamsii* in BOTANICAL GAZETTE, vol. xv. p. 62 (March, 1890). If a Tellima—and I still think it accords better with that genus than with Heuchera—it should probably bear the original name of *T. pentandra*, as given in Prof. Eaton's article. Some botanists, however, may insist on using the specific name which it bears under Heuchera, in which case it would be *T. Williamsii.*—WM. M. CANBY, *Wilmington, Del.*

EDITORIAL.

THERE IS a certain fixity necessary in the terms which are used in descriptive botany; yet if anyone will compare descriptions of plants written 100 — or even 50 — years ago with modern ones the changes that have occurred in terminology will be striking. These changes have crept in almost unperceived in most cases, and have been made in deference to modifications in the morphological concepts. But if the list of terms now in use be scrutinized it will be seen that many do not in the least correspond to the present views of the morphology of the parts. Note for example the terms relating to the flower mentioned by Prof. MacMillan at p. 178; and further such as acaulescent, adnate (anthers), albumen and plumule for the Phanerogams; stipe and frond for the Ferns; areolation, apophysis and acrocarpous for the Mosses; and a host of others that might be specified.

WHAT SHALL be done with such terms? Drop them and substitute the more correct ones, says the morphologist; whereat the systematist raises his hands in holy horror, because the necessity for change does not appear. Nor it is likely that it can be made obvious to him. He is looking at the blue side of the shield; the morphologist at the white. Here is an opportunity for the botanical congress of 1893. It may wisely undertake not only to unite systematists in some common action regarding nomenclature, but take steps toward revising the inconsistent terminology of the science.

WE SAY "of the *science*," for morphology is by no means guiltless in this matter. The most thorough attempt to revise the terminology of the reproductive organs of cryptogams was made a few years ago by Bennett and Murray. Though not wholly consistent nor wise, the move was in the right direction and their suggestions might serve as a basis for future revision.

CURRENT LITERATURE.

The Podostemaceæ.

Warming's paper on this family[1] contains an admirable account of the characters of this small, but very interesting family, the position of which, formerly in dispute, the author states to be close to the *Saxifragaceæ*. Several years ago Mr. Warming made a special study of this family, and the present paper contains most of the results of the investigations, which have been made with his usual acuteness in morphological and anatomical questions. The structure of the vege-

[1] WARMING, EUG.—Podostemaceæ in Engler und Prantl: Die natuerlichen Pflanzenfamilien III. 2. a. Leipzig: Wilhelm Engelmann. September, 1890.

tative organs is peculiar. The roots of these plants show in several species a function, corresponding to that of a rhizome, and have hitherto often been considered as identical with a "thallus" or a "stem." They are always dorsiventral and often strongly flattened; one genus, *Tristicha*, is, however, according to Cario evidently destitute of any kind of roots. As to the internal structure of the roots, there is neither any endodermis nor pericycle, but the central-cylinder is surrounded by a collenchymatic tissue, which is especially strongly developed on the dorsal face; the groups of leptome occupy the dorsal face of the central-cylinder, and are not in alternation with the groups of hadrome, here being situated on the ventral face. The groups of hadrome, commonly two, contain a few narrow vessels, but seem, however, in some cases to be entirely wanting, thus the cylinder looks as if it merely consisted of leptome. The roots showed otherwise a more or less large-celled parenchyma with deposits of starch.

Two different kinds of organs have been observed as fixing the roots to the substratum: "hairs" with the structure of true roothairs, but with the properties of rhizoids; and the so called "hapters." These last organs have been described more completely in a special paper by the same author[1]. They are exogenous and are constantly developed from the base of the shoots; they show a conical shape as long as they have not yet reached the substratum, but after that they become flattened and show usually a more or less digitate lobation, the lobes closely fastened to the substratum, and exuding a brownish secretion. These "hapters," which remind one very much of similar organs of the *Fucaceæ* and *Laminariaceæ* show a very simple structure, consisting merely of a parenchymatic tissue, in which the author observed the presence of siliceous concretions. The hapters have no root-cap, but are able to regenerate like true roots.

The shoots are developed in acropetal succession from the sides of the flattened roots, or in some cases a little towards the ventral face; they appear usually in pairs, more or less opposite, and are developed from the outermost layer of the bark, without being in contact with the central-cylinder. They resemble the roots fixed to the substratum by rhizoids and hapters, and are more or less dorsiventral.

The leaves show a great variation in size and shape; the first developed are scale-like, succeeded by the mostly alternating proper leaves, the blade of which may vary from simple and very small as in *Tristicha* and several species of *Podostemon*, until larger and deeply cleft as in most species of this family.

The paper is illustrated by 17 figures, mostly original and finely drawn by the author himself.—THEO. HOLM.

---

[1] Botanische Notizen. Bot. Zeitung, 1883.

Forest trees of North America.[1]

This brochure of plates will come as a surprise to almost every botanist. Very few, even of Dr. Gray's friends, were aware of the existence of these plates or of the projected work which they were intended to illustrate. They were stored at his house and after his death were sent to the Smithsonian Institution whose property they were. The 300 copies are now "distributed to the principal botanists and museums of the world as mementos of the distinguished man who gave so much of his life and labors to this department of knowledge." The few plates now published (from Mr. Isaac Sprague's admirable drawing) make us wish that the expensiveness of the undertaking and Dr. Gray's preoccupation had not prevented the preparation of text and the completion of the work. We may well congratulate ourselves, however, that the Secretary of the Smithsonian Institution has authorized the distribution of them, even in their incompleteness.

Botanist's Directory.

The useful Correspondance Botanique of Morren having become antiquated Wilhelm Engelmann of Leipzig, the well-known publisher, has issued a list of living botanists, of botanical institutes, societies and periodicals[2].

The compilers are hidden behind the term "Fachmänner." Of course one looks first at the addresses of his own countrymen. For the United States we find many of them sadly awry, and it is a pity that the MS. or the proof was not submitted to some American "Fachmann." We could name a dozen who could have corrected three-fourths of the errors and have added many names worthy of insertion. However, the main value of the book to Americans lies not so much in the accuracy of the American addresses as in those of foreigners. We may well believe that for the continent of Europe at least the work much surpasses in fullness and accuracy the United States section. It is sure to prove of great use to all who have any European correspondence or who wish to be able to distribute papers or specimens wisely. The addresses are grouped by cities, and an index of persons and one of places at the end enables one to find any address of which he has even an inkling. The publisher will be grateful for notice of corrections. We hope that American botanists will see to it that their addresses are correctly given in future editions.

---

[1] Botanisches Adressbuch. Verzeichnis der lebenden Botaniker, sowie der botanischen Anstalten, Gesellschaften und Zeitschriften, herausgeben von Fachmænnern. 8 vo. pp. 186. Leipzig: Wm. Engelmann, 1891.—M. 5.

[2] GRAY, ASA.—Plates prepared between the years 1849 and 1859, to accompany a report on the forest trees of North America. 4°. pp. 4. plates 23, colored. Washington: Smithsonian Institution. 1891.

OPEN LETTERS.

The home of Calypso.

Some years ago, while making a botanical exchange with Prof. W. W. Bailey, the poet-botanist of Rhode Island, I was accused by him of prodigality, because I sent him so many specimens of Calypso borealis. But I could then afford to be prodigal, for I was located in the very court of the goddess, viz:– the cedar region of northern Vermont.

Two years ago I met, at his summer home under the shadow of Mt. Lafayette, the genial author, botanist and world-wide traveler, Dr. Prime. To him I boasted that in half a day I could gather, in Caledonia Co., Vt., fifty specimens of Calypso. He thought that, in Essex Co., he could, in the same length of time, gather a hundred. The two counties are adjacent, and cold, cedar swamps abound in both. Even there it must be reckoned as a very rare plant; but I have wondered if, in any other state, it is as little rare. It is found in Maine, on the Mohawk, in Wisconsin and Minnesota, in Oregon and Washington, and in the British provinces. But, if one may judge by the parsimony which most collectors evince in parting with specimens, it is nowhere found as plentiful as in the locality mentioned.

It prefers the shade of the arbor-vitæ. It grows on low, moist ground — not wet ground — but on knolls a foot or so above the swamp level. A mass of dead Sphagnum overgrown by a thick layer of Hypnum is its favorite bed. The corm and roots rest entirely in the moss, seeming to have little or no connection with the underlying humus. Two or more corms are often united, the one of the preceding year persisting.

Though searching carefully, I have never found fruit. This must be from lack of fertilization by insects. At the blooming season — May 15 to May 30 — there are few insects abroad. I have never seen one hovering about Calypso.

The pressed specimen gives but a poor idea of the beauty of the flower. Pressing usually throws the lip up out of position, giving it a ringent, flaunting, turn-up-your-nose sort of a look, but as it grows, the lip is obliquely pendant — as much so as that of Cypripedium acaule. Dainty beauty is the fitting title. It is comparable only to a bright, modest girl dressed in pink. In Wood's Class-Book of Botany (1846), the flower is said to be as "large as that of a Cypripedium". He must have had Cypripedium arietinum in mind, for no other species of native Cypripedium has a flower so small. Of forty specimens of Calypso, the length of lip averages less than three-quarters of an inch, and in some it is barely half an inch. The same specimens give, average height of plant, including corm, 4.9 inches: average length of leaf-blade, 1.3 inches: average width, 1.1 in. Of these, three have two flowering stalks, apparently from the same corm.

Some stations in Vermont where Calypso was formerly found are known to be exhausted owing to clearing of the woodland, but there is comparatively little danger of its extinction in the region of which I speak. In spite of its pink perianth, it is hard to find, and an expert collector might pass it by unseen. Moreover, many of its haunts are likely to be left in timber perpetually. So I think that northern

Vermont may fairly be called the home of Calypso, but if some botanist between Sitka and Superior shall write me that he finds Calypso as common as Carex—why, I congratulate him, that's all.—F. BLANCHARD, *Washington, D. C.*—[See p. 230. EDS.]

NOTES AND NEWS.

J. W. TOUMEY has been elected botanist to the state college and experiment station at Tucson, Arizona.

THE LAST part of a key to the genera and species of British mosses by Rev. H. G. Jameson appears in the July *Journal of Botany*.

THE SUMMER school of botany at Harvard University closed August 1 a very successful 5-weeks session. About 20 were in attendance.

PROF. DR. KARL von Nägeli, of the University of Munich, author of many valuable botanical works, and a philosophical botanist of deep insight, is dead at 74 years of age.

THE LIBRARY of the late Dr. Schenk and that of Dr. Karl Sanio, who died last February, have been purchased by Weigel (Leipzig) and the works will shortly be offered for sale.

DR. EDWARD PALMER, the well known collector, started about the middle of July for a year's exploration of western Mexico. His friends will be glad to know that he is much improved in health and anticipates a very profitable year of work.

VON TUBEUF has lately published a book[1] which contains good and practical hints as to the identification of German forest-trees at a stage shortly after the germination, together with descriptions of the fruits and seeds of the same trees. Although strictly confined to the native or cultivated forest-trees of Germany, the book might undoubtedly be of some interest and use also to American students in this line.—T. H.

C. SAUVAGEAU has made a very comprehensive study of the leaf-structure of the *Potamogetonaceæ.*[2] The principal purpose of his investigations were not only to give a general sketch of the internal structure of the leaf, but also to show the importance of anatomical characters in identifying species, when represented merely by fragments; and finally to illustrate the relation between structure and medium. After giving some introductory remarks concerning the classification of this group and the general influence of medium upon structure, the author describes and figures the leaf-structure of representatives of the *Zostereæ*, *Posidonieæ*, *Potamogetoneæ*, *Cymodoceæ* and *Zannichellieæ*. The paper contains several new observations besides valuable references and comparisons with similar studies, made by others.—T. H.

---

[1] Samen, Fruechte und Keimlinge der in Deutschland heimischen oder eingeführten forstlichen Culturpflanzen. Berlin, 1891.

[2] Sur les feuilles de quelques Monocotylédones aquatiques. *Dissert.* pp. 200. Paris, 1891.

VOL. XVI. NO. 9.—BOTANICAL GAZETTE.—SEPT., 1891.

The Future of Systematic Botany.[1]

JOHN M. COULTER.

In his presidential address before the Biological Section of the British Association, in September, 1888, Dr. W. T. Thiselton-Dyer closed with the following words:

"At the bottom of every great branch of biological inquiry it has never been possible to neglect the study of plants, nay more, the study of plant-life has generally given the key to the true course of investigation Whether you take the problems of geographical distribution, the most obscure points in the theory of organic evolution, or the innermost secrets of vital phenomena, whether in health or disease, not to consider plants is still, in the words of Mr Darwin, 'a gigantic oversight, for these would simplify the problem '"

If this broad claim be true, a botanical theme is an eminently appropriate one to present to a Biological Section. In the opinion of many, however, all kinds of botanical work are not equally bound up in the bundle of biological inquiry. It is for this very reason that I have selected as my subject "The Future of Systematic Botany."

I know that it is unscientific to deal with the future, although our knowledge of the past and present becomes especially fascinating when we begin to turn it into prophecy. Moreover, upon occasions like this, it is more customary to review and sum up actual knowledge than to cast the horoscope of the future, although the latter is far easier. But, setting aside the custom of presenting either an interesting bit of research or a summarized view of information concerning some attractive subject, I would invite your attention to an ancient, and, to my notion, a much abused department of work. It is perhaps well to say in the outset that the abuse to which I refer is not only that inflicted by Gentiles, but also by Jews; for often one's worst foes are those of his own household.

The ancient history of Systematic Botany is too well known to this audience to need even brief repetition, especially since the masterly sketch by Professor Sachs has found its place in all our libraries. The names of illustrious systematists are household words, and their various "systems" form

[1] Vice-Presidential Address before Section F., A A A S., Washington meeting, August 19, 1891.

a part of our training. The one desire which runs with increasing purpose through all this well known history is to reach eventually a natural system of classification. The one obstacle in the way of gratifying this desire has been a lack of knowledge. You remember the time when the knowledge of affinities was so slight that no attempt even was made to express relationships, and plants were simply systematically pigeon-holed for future reference. The ingenuity of those days was taxed to construct the most convenient pigeon-holes, and to properly assign to them the hosts of plants that were clamoring for recognition. Those who could thus properly assort a collection of plants, and could recognize when a new pigeon-hole was needed, were known first as "botanists," afterwards as "systematic botanists," an appellation proper enough, but one unfortunately not having sufficiently outgrown its original application. The unfortunate result of this necessity to systematize facts so rigidly and thus render them readily accessible was, as you well know, to make the pigeon-holes as permanent as the facts they were intended temporarily to contain. A convenience at first became at last a tremendous hindrance, and we are even yet but slowly giving up our firm belief in the reality of the ancient pigeon-hole and its appropriate label. The fact is, that although our belief in them is oozing out, our necessities still compel us to use them; but it is to be hoped that they are being relegated rapidly to their proper position as conveniences, devices of semi-ignorance, and not considered as actual facts.

You also recall how knowledge presently became sufficient to justify an attempt at natural arrangement, crude enough, but still advanced enough to mark an epoch in progress; and the authors of these first "natural arrangements" understood their own limitations better than any one else. One natural arrangement has succeeded another, from that day to this, until in those of to-day we have presented to us simply what the earliest contained, viz.: the expression of man's knowledge of affinity; the difference being a slowly diminishing amount of artificial padding. I need not suggest to you how exceedingly imperfect that knowledge is yet, and how, of necessity, the best of our present systems must meet the fate of those that have gone before and become merely chapters in the history of systematic botany. This becomes doubly apparent when it is considered that "pigeon-holing" is going on almost

as rapidly as ever; although we may fairly consider that we have now in hand sufficient material for the broadest generalizations. I say "material," not meaning by any means to imply the knowledge which proper investigation of this material is to bring us.

Systematic botany, as formerly understood, has probably done all that it can, unaided, in the natural arrangement of plants. Of course it could indefinitely juggle with sequence and nomenclature, but, after all, that is like arranging a card catalogue, and is of such secondary importance, when the real purpose of systematic botany is considered, that it can hardly be taken as indicative of progress. Let me interject a word at this point. It is my impression that the decriers of Systematic Botany have only in mind this "juggling with sequence and nomenclature" when they make their strictures, and are mistaking the art of the tailor for the evolution of the real man. One must be respectably clothed, but he must be an unspeakable idiot if that is all that can be said of him. It has always been my impression that the depreciation of any other kind of scientific work argues either lack of knowledge or conceit.

But the ancient kind of Systematic Botany was not left without aid, and a group of new departments was made possible by the microscope and the unexampled progress of powers and manipulation. The study of the cell, and of nascent and mature organs, and the recognition of plants as living things that are the resultant of the interplay of internal and external-forces, have simply revivified the ancient mummy called Botany, and have made it the living thing it is to-day, capable of endless development. It is not to be wondered at that these new and vigorous departments of work, in the first glow of the vital service they have rendered, should look at the older department as a thing of the past, as something to be buried out of sight, and remembered only as a part of mediæval history. But this is only the first glow of a natural enthusiasm, and I glory in it, for it promises an enormous amount of self-denying work, and the results will all fall into the lap of Systematic Botany. The corpse is not buried, but revivified, and this gush of new work has been but the infusion of an elixir of life into a body that was perishing from starvation.

Some one has said that "the highest reach of the human

mind is a natural system of classification"; and Dr. W. T. Thiselton-Dyer, in the address quoted at the opening of this paper, remarks that "such a classification, to be perfect, must be the ultimate generalization of every scrap of knowledge which we can bring to bear upon the study of plant-affinity."

This simply means that when the results of all departments of botanical work are well in hand, then the systematists will be in a position to put on a sure foundation the structure they have always been planning, for it will rest upon known affinities and not upon unmeaning resemblances. To my view, therefore, the real Systematic Botany is to sum up and utilize the results of all other departments; and its work, so far from belonging entirely to the past, is well-nigh all in the future. It is the highest kind of generalization upon an enormous array of facts, and is bound to be the *last* expression of human thought with reference to plant-life, just as it was the *first*. Systematic Botany, therefore, the Systematic Botany which deals with genetic characters, and recognizes the fact that every plant is a living thing with a history and all degrees of consanguinity, and that "the final form of every natural classification must be to approximate to the order of descent," is in its early infancy, and can only develop to completest power when all the facts of plant origin, structure, and life are in. This would seem to make it a slowly developing department of a somewhat endless future, with every distinct advance in knowledge embodied in some "Natural System." These invaluable "systems" will well stand for a series of approximations towards the truth, each succeeding one probably somewhat nearer than the one before, but still far enough removed to stimulate further research.

My position, therefore, is that for the systematists of to-day and of the future there must be three distinct lines of work, related to each other in natural sequence in the order in which I shall present them, and each turning over its completed product to the next.

I. THE COLLECTION AND DESCRIPTION OF PLANTS.—This *preliminary phase* of Systematic Botany is that which most frequently stands for the whole, especially in the minds of those who have been trained in the ancient fashion. It is really strange why this particular and very necessary phase of systematic work has fallen into disrepute among the younger

botanists; and I can explain it only by the fact that it is the oldest representative of the science, or that it so frequently stands for all of botanical science in the popular mind, and this popular verdict is resented. With this last position I am thoroughly in sympathy; and it is perfectly proper for the public mind to be disabused and made to understand that botany is a science of living things and not merely of mummies; but this can be best done by treating courteously the ancient and ever to be present and necessary work of collection and description. Such workers are curators of botanical material upon an extensive scale, a function that, properly exercised, requires a skill and patience that few possess, but that many assume.

I grant that the discovery and description of new species is such an inspiring pursuit that it may degenerate into a mania, and sometimes into kleptomania; but the worst of it is that it attracts many who are wholly incompetent, and who have burdened our literature with rubbish that is both discreditable and confusing; but this can be no more true of this than of any other phase of botany or scientific work.

I do not desire to be understood as defending this kind of botanical work, for it needs no defense of mine; but simply, in view of certain fraternal thrusts that have been given, less frequently now than formerly, to call attention to the fact that this is one of the living and necessary kinds of botanical work, subject, like all other kinds, to degradation at the hands of its friends.

While I have spoken of this phase of botanical work as the most ancient, and one which, like the poor, we are always to have with us, I by no means intended to imply that its methods cannot be improved. It must have long since occurred to some that many things besides the mere sporadic collection and recording of species should be included as legitimately belonging to this line of research. It is the common plan to collect and record a plant in such an isolated way that it becomes a text without any context, and is thus robbed of much of its significance. Collectors send in from the field large amounts of miscellaneous material, and usually the only accompanying information is a locality, mostly very indefinite, and a date. In some cases the size and habit is appended, and possibly some local economic note. I take it that this

fairly represents the average amount of information obtained from field contact with species; and how meager and unsatisfactory this is can only be appreciated by one who undertakes to make a thorough study of the flora of any region. I have no fault to find with the facts, so far as they go, but they are not half that we have a right to expect from the expenditure of time and energy. There seems to be nothing more unsystematic than field-work in systematic botany. The result is that we know a little about all our floral regions, and all about none, however small. All information that can be obtained in the field concerning species is the province of the collector to procure and of the taxonomist to record This additional information is important, not merely as additional information, but frequently in correcting errors of judgment concerning species. A species surely holds important relations to its environment, and its characters in some unusual position, or in the penumbra of its range, can hardly be taken as typical; and yet this thing of range and relative abundance, involving centers of distribution, is rarely looked after. What I protest against is the search for species as for diamonds, as things solely valuable in themselves, apart from their surroundings; and what I would urge is the conversion of collecting trips into biological surveys. I know that this means the better training of collectors, that they must be not mere manipulators of drying paper, but scientific men; but is that any objection? I would not for a moment disparage the work of that splendid array of collectors who have triumphed over innumerable difficulties in a self-denying way worthy of any cause, and who have brought to light a wealth of material for which we can never be too grateful; but I would claim that the time has now come when the same amount of devoted labor can be expended to better advantage; and that we must train up a race of field-workers who shall follow their profession as distinctly and scientifically as the race of topographers. In this center of public scientific work in which we have met, devoted to obtaining the largest amount of information in regard to our national possessions, and with means commensurate with the largest plans, it seems an appropriate thing to urge a thoroughly equipped system of biological surveys. This subject is not a new one here, and steps have already been taken to organize some work of this kind, but I desire

to voice the sentiment of this section in commending all that has been done in this direction, and in urging that the organization be made more general and extensive.

With regard to the work of description I have little more to say than to express a feeling of regret that it is not always wisely done. This feeling, however, is not peculiar to any kind of work, and it must be always a jumble of good, bad and indifferent. It is simply a case of "let him that is without sin among you first cast a stone," and the man who publishes nothing that he afterwards regrets is either a transcendent genius or a simpleton. It might as well be accepted, however, that description will continue as before, probably in an increasingly miscellaneous way, for there is no feasible way of restricting it, even if it were desirable. We can simply urge, and continue to urge the necessity of long training, abundance of material and literature, and a patience that will be content to wait. Dr. Asa Gray, in a short paper that has never been published, has this to say:

"The publication of new species is always an anxious business to those fitted for the work and impressed by the responsibility of it, and is lightly undertaken only by those who have no appreciation of the trouble and labor they are giving to the faithful working botanist, both now and hereafter. Some enter upon this seemingly in the spirit in which an ill-disposed person was recommended to throw as much dirt as possible, on the chance that some may stick The aggrieved author of monographs, floras, and bibliographical indexes has all this dirt (matter out of place) to take care of. He has enough to do in rightly arranging and ascertaining the limits and characters of the species of a difficult genus, without being vexed with riddles which, when solved, often prove to be curiosities of ignorance or marvels of recklessness The added misfortune is, that superfluous names, however needless or absurd, cannot be buried in oblivion, but must be embalmed in synonymy."

There seems to be abundant indication that, with a better conception of the limitations of a species, the old characters will yield in importance to new ones of deeper significance. The microscope, which was necessary to reveal the existence of any usable characters in the lower groups of plants, is rapidly becoming hardly less necessary for satisfactory systematic work in the highest groups. While the use of gross organs will probably never disappear in specific discriminations, their *exclusive* use must be given up, and such characters will be supplemented by minute ones, which their very minuteness renders of more permanent diagnostic value. You are all familiar with several troublesome groups in which minute characters have already been made of great service in steadying characters obtained from the gross, the largely used, and

hence the variable organs. I look upon this as one of the most promising features of the work of future taxonomists of the higher groups.

The serious danger lurking just here is that when one set of characters has proved serviceable in a number of specific or generic limitations the tendency is to make the fabric of the whole group conform to that one set. This gives, of course, a kind of mathematical precision, and every problem is solved by the same formula. But, unfortunately, nature never conforms to such arbitrary rules, and the resulting arrangement may be as purely artificial as those that are confessedly so. The character of a species is an extremely composite affair, and it must stand or fall by the *sum total* of its peculiarities and not by a single one. A specific character in one group may be a generic character in a closely related one, or no character at all. Therefore, there is nothing that involves a broader grasp of facts, the use of an inspiration rather than a rule, than the proper discrimination of species. I have a belief that the arbitrary, rule-of-three mind will never make a successful taxonomist; and that there is a sort of instinct for specific limitations which the possessor cannot communicate to another. This taking into account the total character of a plant, from *facies* to minute characters, will furnish the basis of future descriptive work. The more obstacles that can be put in the way of hasty determination the better.

I have dwelt thus upon the work of collection and description, both to magnify it and to indicate that its proper position is that of a preliminary phase in the study of Systematic Botany.

II. THE STUDY OF LIFE-HISTORIES.—A second phase of Systematic Botany may be called the study of life-histories. It follows the former in natural as well as historical sequence, and, curiously enough, its votaries do not usually class themselves with systematists, although their work is chiefly an attempt to discover affinities. True, they deal in the main with the larger groupings, but this is only possible when a wealth of species is at hand. By "life-history" I do not mean simply that gross observation which watches a plant from germination to maturity, although that must be considered an extremely useful service; but even more that minute tracing, cell by cell, from the primitive cell to the mature plant, a work which is now conceded to reveal more

of the deep secrets of affinity than perhaps any other. The tremendous amount of material to be thus investigated, and the numerous obstacles to be overcome, have been the chief stimulus of recent botanical activity; and there has sprung into existence a race of workers whose powers of manipulation are little short of marvelous. These observers are bringing the hidden things to light, and out of the facts they are accumulating is to be constructed the Natural System. But the field is comparatively a new one, and the material so exhaustless that it can well satisfy the ambition of the most diligent. I would consider this work of searching for the affinities of great groups the crying need of Systematic Botany to-day. The need is so evident, and the work so attractive, that there is no lack of numbers in those who are undertaking it. The multiplication of facilities for this work is all that could be asked; but too often "facilities for work" and a little knowledge of technique are considered to be the only things necessary for this difficult kind of investigation. The consequence is that "life histories" have been published which are not histories of any living thing. The amount of work to be done is so great, and the use to be made of the results is so important, that incompetent work is peculiarly exasperating. Nothing is more capable of misinterpretation than the observations made in work of this nature, and the tendency to generalize upon few or even doubtful facts is a constant temptation.

It is really a question as yet, whether, even among skillful investigators, too much stress is not laid upon certain single characters, and the sum-total of development not sufficiently considered. There is a marked tendency to select certain parts of certain organs and square the affinities of the whole organism by these, rather than to consider them in the light of cumulative testimony, to be used in connection with others. The tendency is not pernicious, for it is rapidly accumulating a vast amount of partial testimony, but the broadest generalizations concerning affinity cannot be made until every part of every organ is considered, and the position of the organism be made the resultant of all. There is no question but that certain periods in the development of a plant, or certain important organs, notably the sexual ones, are freighted with deeper meaning than others and rightly exercise a dominating influence in determining affinities; but development at every

period, and of every organ, must eventually be taken into account before the last word can be spoken concerning a Natural System. The possibilities of adaptation seem so great that it is possible to conceive of two forms closely related in fact, but widely separated by some scheme which depends upon any one set of organs however dominant. For example, this trouble has been experienced over and over again in all presentations of Thallophytes, and will probably continue to be experienced so long as some single key is used to unlock all the mysteries of affinity. I cannot see why a single set of characters used by an embryologist may not result in as artificial a scheme as the use of two or three organs by the taxonomist.

I have thus spoken of the study of life-histories to indicate that its chief function lies in the field of Systematic Botany; to suggest that it take into account development at every period and of every organ, and so obtain a mass of cumulative evidence for safe generalization; and to urge upon those not thoroughly equipped great caution in publication.

I fear that what has been said concerning the great difficulty of the work of the two phases of Systematic Botany already mentioned may be taken to imply that there is nothing here for the poorly equipped but well-intentioned to do. My frank opinion is that there is an abundance of service that such can render, and that their chief function is to bring facts to the notice of those who know how to use them. Very few of us can be architects, but almost any one can carry brick and mortar.

III. THE CONSTRUCTION OF A NATURAL SYSTEM.—This is, of necessity, the last phase of Systematic Botany, and it is evident that its work will not be complete until the two previous kinds of work have been exhausted. The fact is, it must lay under tribute every department of botanical work, and be a compendious expression of man's knowledge of the affinities of plants. It is just here that the work of the tyro is most common and least harmful; for crude systems need not annoy, they can be buried and no law requires their embalming, no necessity compels a verification of their facts, for no facts are used except such as are already known. I venture the assertion that few botanists can truthfully deny that in the early and most ambitious stage of their development they either had in mind, or were rash enough to publish some idea that

was to simplify the whole scheme of plant arrangement. This tendency may have soon been checked by wise friends or sad experience, but to attack the largest problems first is as natural as youth itself. I speak of this, not only as a generalization, but also as a reminiscence.

But these Phaeton-like attempts aside, wherein lies the necessity of this most difficult work before the facts are all in, this attempting what is conceded to be impossible? Is it of any advantage to construct a system to-day which must be found faulty to-morrow? It is of the highest advantage to construct any system which shall embody every known fact concerning affinity. Every such system becomes, as ought to be clearly understood, simply an expression of our imperfect knowledge, a convenient summary of information, a sort of mile-post to tell us how far we have come, and to direct future effort. In his essay upon "The Significance of Sexual Reproduction in the Theory of Natural Selection," Weismann uses these words, which are well worth quoting in this connection:

> "Instead of comparing the progress of science to a building, I should prefer to compare it to a mining operation, undertaken in order to open a freely branching lode Such a lode must not be attacked from one point alone, but from many points simultaneously From some of these we should quickly reach the deep-seated parts of the lode, from others we should only reach its superficial parts; but from every point some knowledge of the *tout ensemble* of the lode would be gained And the more numerous the points of attack, the more complete would be the knowledge acquired, for valuable insight will be obtained in every place where the work is carried on with discretion and perseverence But discretion is indispensable for a fruitful result; or, leaving our metaphor, facts must be connected together by theories, if science is to advance Just as theories are valueless without a firm basis of facts, so the mere collection of facts, without relation and without coherence, is utterly valueless. Science is impossible without hypotheses and theories, they are the plummets with which we test the depth of the ocean of unknown phenomena, and thus determine the future course to be pursued on our voyage of discovery They do not give us absolute knowledge, but they afford us as much insight as it is possible for us to gain at the present time To go on investigating, without the guidance of theories, is like attempting to walk in a thick mist without a compass We should get somewhere under these circumstances, but chance alone would determine whether we should reach a stony desert of unintelligible facts or a system of roads leading in some useful direction; and in most cases chance would decide against us"

It becomes very evident that the work of constructing even a Natural System which must be tentative, a sort of temporary scaffold, is one which demands not only the widest range of information (and hence a task which is daily becoming more exacting), but also that broad grasp in generalization which is possessed by very few. The marshaling of facts is like the marshaling of armies, and very few are born generals. Almost any one can arrange the plant kingdom who is pos-

sessed of but few facts, but he who has them all within his reach finds no more difficult task; for it is like fitting together a puzzle of endless pieces.

The question might arise as to the duty of ordinary manuals in this respect, books of limited range, that do not profess to undertake such a path-breaking operation as the construction of a new Natural System. It has always been my opinion that even the most local manual should be an expression of the ascertained facts of affinity. This statement is by no means so sweeping as it may at first appear; for it does not contemplate including the scores of crude notions which are always being advanced, so attractive to many who are naturally restless and mistake change for progress. In the statement made, I desire to emphasize the words "ascertained facts of affinity;" and this is very far from permitting the use of every random notion that may happen to be published. The facts of affinity are slowly accumulating, facts which have reached the dignity of general consent, and it is such that I would always have incorporated even in local manuals, which should not be subjected to the continuous shaking of treacherous ground. I am fully aware that there is a conservatism which is an obstruction to progress; just as there is a galloping rapidity which would land us in the mire; and that we probably all possess one of these qualities in our anxiety to escape the dangers of the other.

The points presented then, in this consideration of the third phase of Systematic Botany are, that the last and highest expression of systematic work is the construction of a Natural System, based upon the accumulations of those who collect and describe, and those who study life-histories; that this work involves the completest command of literature and the highest powers of generalization; that it is essential to progress for a Natural System to be attempted with every advance in knowledge; and that all the known facts of affinity, thus brought within reach, should be expressed in all systematic literature.

In conclusion, I have but to say that I have attempted to indicate the true relation which exists among the different phases of Systematic Botany; to point out an affinity which there is danger of ignoring; and to maintain that all these departments of work, looking to the same end, are equally important, equally honorable.

Indiana University, Bloomington, Ind.

Botanical papers at the Washington meeting of the A. A. A. S.

At this meeting, beginning August 19, an unusually large number of botanical papers were presented, of which we give the following abstracts:

The possibilities of Economic Botany: the address of the retiring president of the association, DR. GEORGE L. GOODALE.—The address was introduced by a brief description of the speaker's recent trip through Australasia and Japan, where many of our possible economic plants were met. Many examples were given of the useful plants which mankind may hope to employ in the near future. The assertion was made that if all our present cereals were swept out of existence our experiment stations could probably replace them by other grasses within half a century, the methods being selection and hybridization. New vegetables may reasonably be expected from Japan, a country whose flora has such remarkable resemblance to our own. The fruits of the future will tend more and more toward becoming seedless, just as certain fruits are now. All the great groups of economic products were taken up in turn and their possible improvement described. The speaker urged the importance of the establishment of a series of gardens in different parts of the country, where experiments can be carried on in hybridizing and selection, and expressed the opinion that such establishments should be neither governmental nor academic. A complete abstract of the address is not possible, as it was a collection of facts that cannot be condensed. The paper will be published in full in the *Am. Jour. of Science* for October, and also, translated into German, in the Pharmaceutische Rundschau. It is an exceedingly valuable contribution to the literature of Economic Botany.

Illustrations of heredity in plant hybrids: DR. J. M. MACFARLANE, of Edinburgh University.—This address was the public lecture of Friday evening and was fully illustrated by the use of three lanterns, showing side by side the structures of each parent and the hybrid. The points made were as follows: Some hybrids are exactly intermediate in histological details between parents. Parents in such cases are nearly related histologically and the progeny often fertile. Some

hybrids while intermediate in most details inherit two diverse structures peculiar to each parent. Such hybrids are usually largely sterile. Effects of heredity were traced in flowering period, color, chemical constitution and powers of resistance, showing that an organism is normally an equal blending of both parents. Explanation was offered of cases where the offspring resembles one parent rather than another.

The future of Systematic Botany: JOHN M. COULTER.—The vice-presidential address is printed in full in this issue.

The botanical papers before section F were as follows:

On the structure and dimorphism of Hypocrea tuberiformis *B. & Rav.:* GEO. F. ATKINSON.—H. tuberiformis was described by Berkeley in *Grevillea*, 4. 13, from specimens collected by Ravenel in S. C. It was also distributed in Rav. Fung. Am. n. 733, and in Rav. Fung. Car. n. 52. The perfect stage has never been described. Patouillard described a new genus *(Dussiella)* from specimens of a fungus in the Berlin Museum, which was wrongly determined as *Hypocrea tuberiformis* B. & Rav. It was collected in Caracas and is very different from the American specimens on Arundinaria, the perithecia being entirely immersed in the stroma and accompanied by paraphyses, while in the American specimens the perithecia are sessile and stand on the stroma "like the young horns of Podosma macropus." The fungus is closely related to Epichloe, but as the stroma does not entirely surround its host it would fall into the genus unnecessarily erected by Saccardo, and for the time being would read *Hypocrella tuberiformis* (B. & Rav.).

The spectroscope in botanical studies: I. A. BRASHEAR.—A simple method of studying the selective absorption and reflection of flowers and leaves by means of the spectroscope was suggested. The author gave the results of a number of studies on the colors of flowers and leaves, illustrating results by means of diagrams

On the prothallium and embryo of Osmunda Claytoniana and O. cinnamomea: DOUGLAS H. CAMPBELL.—The author treated at length the structure and germination of the spores; the development of the prothallium, the structure and development of the sexual organs, fertilization, the development of the embryo with comparison in the two species; closing with

a comparison of the development with that of other Pteridophytes, and a discussion of the systematic position of the Osmundaceæ.

On the phylogeny of the Archegoniata: DOUGLAS H. CAMPBELL.—In this paper, in a certain sense a sequel to the preceding, Dr. Campbell detailed the different views held as to the relation of Hepaticæ and Musci to each other and to the Pteridophytes, and stating the hypothesis as to the primitive nature of the Eusporangiate Pteridophytes, the author claimed an evident inter-relationship of the different groups of the Hepaticæ, showing the connection between the thallose and foliose Hepaticæ, and between the former and the mosses. A comparison of the Pteridophytes and Hepaticæ was followed by a consideration of the relationships of the Pteridophytes *inter se*, of heterospory among the Pteridophytes, and of the relation to Gymnosperms and Angiosperms.

Further observations on a bacterial disease of oats: B. T. GALLOWAY.—After a brief review of the paper read on this subject at the Indianapolis meeting, the life history of the organism was set forth, it being shown that the germ may pass the winter on seed from diseased plants, on volunteer oats and to a limited extent in the soil. The characteristics of the germ as regards its behavior on different culture media were given, together with the results of inoculation experiments. In conclusion the experiments in combating the disease and the results obtained were given.

A new Nectria: B. D. HALSTED.—The stem rot of sweet potato is a puzzling disease. As the decay begins near the surface of the ground, and works in opposite directions, usually several fungi are found in the affected parts. A species of Fusarium is uniformly abundant upon the aerial decaying stems. Early in June an ascigerous fungus was found upon the underground portions of the young plants and was first thought to be a form of black rot. It is, however, a Nectria and somewhat closely related to *Nectria Vandæ* Warh.

Notes upon bacteria of Cucurbits: B. D. HALSTED.—Melons, squash and cucumber plants have suffered from a bacterial disease during the present year in New Jersey. The stem decays near the ground and the leaves wilt and "melt" away. The germs are oval in shape and inoculations of healthy plants were successfully made by means of a flamed

glass rod. In like manner the disease can be introduced into the stems and leaves of various species of cucurbits. The same bacteria develop with rapidity in ripe tomato fruit upon the vines and spread through the stems of the inoculated plants.

Another chapter in the history of the Venus' Fly-Trap: J. M. MACFARLANE.—It was shown that for mechanical stimulation of leaf *two* touches are needed to cause contraction (unless the stimulus be very powerful), separated by a greater interval than $\frac{1}{3}$ of a second. If less than $\frac{1}{3}$ of a second elapses, there is no contraction and a third touch is then needed. In the first case no effect is produced if 35–40 seconds elapse between stimuli. By repeated stimuli, with intervals of 40 seconds between, the protoplasm becomes fatigued, so that when the time interval is reduced sluggish movement is exhibited. All parts of the lamina are sensitive to surface stimulation. The author claimed that the explanation of the behavior to stimulating and non-stimulating bodies is to be found in the tetanus of the leaf, first produced by mechanical and later by chemical stimuli. The behavior in this respect of numerous organic and inorganic substances was noted, as was also the agreement of these with Burdon-Sanderson's electrometer results. The nature of the digestive excretion was considered, together with the structure of the leaf in relation to contraction and excretion. The author, in concluding, claimed a perfect parallelism between combined nerve and muscular action in animals, and contraction action in Dionæa. The paper was illustrated by testing the observations made upon some magnificent Dionæas, obtained from the government Botanic Garden.

The Compositæ collected by Dr. Edward Palmer in Colima: J. N. ROSE.—Of the 515 species of plants collected by Dr. Palmer in the State of Colima, 61, or about 12 per cent., are Compositæ. Among these were six new species and two new genera, together with a number of rare forms, some of which had not been collected for more than 100 years.

The Flora of Carmen Island: J. N. ROSE.—This contained a sketch of the collections made in this island by Dr. Edward Palmer in 1870 and in 1890, Dr. Palmer being the only collector who has ever visited the locality. The total number of species obtained was 70, and of these six are new. Group-

ing the plants into Polypetalæ, Gamopetalæ, Apetalæ, and Endogens, it was found that of polypetalous forms there were 21 species, 7 of which were Leguminosæ; of gamopetalous 24 species, 12 of which were Compositæ; of apetalous 10 species, 6 being Euphorbiaceæ, and of endogens 13 species, 12 being Gramineæ. Twenty-nine of the species have been reported from Mexico and forty-nine from Lower California.

Uses of the fermentation tube in bacteriology: THEOBALD SMITH.—The object of the paper was to call attention to the value of the fermentation tube in the differentiation of closely allied species or varieties of bacteria, in the preliminary study of gas production and in the cultivation of anaerobic forms. It was also shown to be very useful in the class room in demonstrating the very active metabolism of bacteria as indicated by the rapidity of gas production.

Botanical field work of the Botanical Division: GEORGE VASEY.—This paper gave an account of the field work or botanical explorations which are being conducted by the Botanical Division of the Department of Agriculture. The sketch included an account of the work in Texas, with a list of new species; the bulletin of the Texas Flora; the work in Arizona and in Mexico, with an account of some species of special interest; the Death Valley Expedition; the special investigations in Cactaceæ; the explorations in Indian territory, N. E. Minnesota and Wisconsin, and in Florida.

Results from recent investigations in pear blight: M. B. WAITE.—Pear blight is a disease which works only in meristematic tissue. After explaining twig and blossom blight and detailing methods of study the writer gave some of the characteristics of the germ blight. It is a motile bacillus. The blight bacteria grow in the nectar and multiply there as saprophytes and then enter the tissues. The bacillus of blight in the nectar is carried from flower to flower by insects visiting the flowers for pollen and honey. An artificial epidemic of pear blight was started by infecting a few trees on the edge of an orchard and allowing free access of insects. Protecting the flowers from visits of insects will protect from blight.

In addition to the above papers, the four following were presented, by appointment at the Indianapolis meeting, under the general title of *Plant Physiology*.

Transpiration, or the loss of water from plants: CHARLES E. BESSEY and ALBERT F. WOOD.—The historical summary of the investigations upon transpiration was followed by a discussion of the methods of observation and the nature of transpiration. The paper closed with a summary of the views of the principal investigators.

Absorption of fluids by plants: L. H. PAMMEL.—The paper opened with a résumé of the work upon the absorption of fluids by plants, considered historically, anatomically and physiologically. The subject of soils was then considered as bearing upon the absorption of water. The distribution and occurrence of root hairs on plants with an exposition of the way in which absorption was brought about was then discussed, the paper closing with an account of the absorption of fluids by Cryptogams.

Movement of fluids in plants: W. J. BEAL.—The author gave a résumé of the subject, speaking chiefly of the movement of fluids in trees. His remarks were confirmed by a number of experiments that he had performed for verification.

Gases in plants: J. C. ARTHUR.—The writer gave a brief historical statement of the discovery of the principal facts pertaining to the subject; the kinds and origin of gases in plants; and an account of the present state of knowledge regarding the movement and distribution of gases in plants.

Two papers of botanical interest were read before section C (Chemistry).

The biological function of the lecithins: WALTER MAXWELL.—In a paper presented before the association in 1890, it was shown that during the initial stages of plant growth, the phosphorus contained in the mature seed as a mineral phosphate, under the action of the process of germination, becomes separated from the inorganic compound and reappears in the organisms of the young plantlet in an organic form as lecithin, and that the lecithins form a medium through which the element phosphorus passes from the mineral to the vegetable kingdom. A continuance of the study of the functions of the lecithins, which has been conducted with the normal hen's egg and the incubation products of the egg, have indicated that the phosphorus contained in the egg in the organic form as a lecithin, under the action of the process of incubation, becomes eliminated from the lecithin compound

and reappears in the mineral form as a phosphate, and is utilized in the production of animal bone. It thus appears that the lecithin bodies are a channel through which the circulation of the element phosphorus is conducted, passing from the mineral, through the vegetable and into the animal kingdom.

Raphides the cause of the acridity of certain plants: H. A. WEBER.—Chemical tests show that the reason why some plants, like Arisæma, are acrid, while others also abundantly supplied with raphides, like Tradescantia, are not acrid is because the latter have the bundles of raphides surrounded by an insoluble envelope, not present in the former. In the one case the raphides are readily dissolved in the mouth and produce the biting sensation; in the other case they do not dissolve and consequently cannot be tasted.

Botanical Club of the A. A. A. S.

The meetings of the club were held from 9 to 10 A. M., on Thursday, Friday and Saturday of the session of the Association. They were well attended, quite as well in fact as the Section of Biology which followed later in the day. The number of papers presented was unfortunately limited by the brief sessions, but they were of more than usual interest. The following is a summary of the papers read:

Remarks on some apparatus upon exhibition. J. C. ARTHUR.—A brief description of respiration apparatus exhibited by Dr. Atkinson and himself, and also of some other pieces of physiological apparatus. A student's reagent case was also exhibited by Prof. Beal.

The perfect stage of Cercospora gossipina: GEO. F. ATKINSON.—An account of further studies upon the life history of this parasitic fungus.

Notes on egg plant diseases: B. D. HALSTED.

Distribution of some fungi: L. H. PAMMEL.—A record of the occurrence of some parasitic fungi during 1891. In discussion Prof. L. H. Bailey expressed the opinion that by

extending and increasing such records we might eventually prognosticate with a fair amount of certainty in regard to the probable occurrence of a disease during the coming season, and to state what measures should be taken to hold it in check.

Remarks on a National arboretum: B. E. FERNOW.—After giving reasons why an extensive arboretum at Washington, under the control of the government, would be a valuable acquisition in promoting the development of forestry and allied interests, he presented resolutions addressed to Congress looking to the initiation of such an undertaking. The resolutions were favorably considered, being commended by Messrs. Ward, Riley, Beal, Arthur and others, and were addressed to the Biological Section for further action.

Notes on a new and destructive disease of currant canes: D. G. FAIRCHILD.—An account with drawings and photographs of the dying of the stems, apparently caused by the presence of a mycelial fungus under the bark. No conidial or other fruiting stage was found, although the fungus was made to grow luxuriantly upon slices of potato, agar-agar, etc.

Two new weeds for the United States: J. N. ROSE.—Orobanche racemosa occurs in tobacco and hemp fields in Kentucky, and is also reported from one locality in Illinois. What is locally known as Russian cactus, supposed to have been introduced by Russian Jews, has become a pest in the wheat fields of N. Dakota. It is a species of Salsola. Prof. L. H. Bailey gave an instance of a new introduction spreading at first in a very threatening manner, but which had practically disappeared in four years after. He thought it required a number of years of observation to say with much certainty that a new plant will make a pernicious weed.

The tubercles on the roots of Ceanothus: GEO. F. ATKINSON.—The tubercles discovered by Prof. Beal, and reported upon last year before the Club, were found upon further study to be caused by a parasitic fungus allied to Schinzia Alni, found upon the roots of Alnus and Eleagnus, and now transferred to the genus Frankia.

Notes on the arrow weeds or jumping seeds of Mexico and Central America: C. V. RILEY.—These plants, which are used by the natives to poison arrows, and the seeds of which

have a curious saltatory movement due to the presence of an insect in them, belong to several species of Euphorbiaceous plants. The paper was to record, and to call forth further information on the identity and distribution of the species.

Remarks on the souvenirs prepared by the Botanical Club of Washington: E. F. SMITH.—The souvenirs, consisting of a volume of photographs specially prepared, were presented to members of the club, accompanied by a presentation speech conveying the desire of the local club to make the stay of visiting botanists pleasant and memorable.

Changes in the flora of Franklin county, Ohio, during the past 50 years; a note on plant distribution: W. R. LAZENBY.

Notes on some peculiar fungi: MISS E. A. SOUTHWORTH.—Exhibited and described the structure of a tree fungus, forming indefinite white masses of considerable size, which have been described as a new mineral. They appear to be Fries' plant, Polyporus officinale, but their true nature is yet uncertain.

Notes on Barcyeidamia parasitica Karst.: MRS. E. W. CLAYPOLE.—The fungus was found upon decaying onions from the cellar and always associated with another mould upon which it seemed to be a parasitic. It could not be made to fruit upon artificial culture media.

Methods of collecting and preserving Myxomycetes: O. F. COOK.—For the herbarium the specimens are glued to the cardboard, when not too thick, and another card board laid over the specimen, which is kept from crushing it by strips of cork, and the whole placed in the ordinary packet for fungi. When too thick for this treatment, the card to which the specimen is glued is turned bottom side up into a suitable pasteboard box, which has pieces of cork glued to the inside ends, permitting the card to enter the box only far enough to allow the cover to be put on. The two methods are intended to displace the use of pill boxes.

Remarks on a new and destructive herbarium insect: L. H. DEWEY.—This appears to be unusually dangerous for large collections, as corrosive sublimate does not always check it. It is a geometrid moth, hitherto undescribed, looking in its mature form much like the common clothes moth.

New and little known plants of Alabama: CHAS. MOHR.—Among the rare plants mentioned was Quercus heterophylla.

In the discussion which followed Mr. Martindale spoke of the importance of learning still more of the distribution of this species. Mr. Canby thought it a good species. He had specimens in his herbarium from N. Carolina collected by Curtis.

Resolutions were heartily adopted thanking the Botanical Club of Washington for the handsome souvenirs, and for other attentions, which added to the pleasure of the botanists in attendance upon the association.

The following officers were elected for the next meeting: President, V. M. SPALDING, of Ann Arbor, Mich., Vice-President, J. M. COULTER, of Bloomington, Ind , Secretary, D. G. FAIRCHILD, of Washington, D. C.

The Botanical Section of the American Association of Agricultural Colleges and Experiment Stations.—Washington Meeting.

GEO. F. ATKINSON, SEC'Y *pro tem.*

The Section met August 13, in Columbian University, with Chairman B. D. Halsted presiding and Geo. F. Atkinson as secretary *pro tem.* No program being prepared the chairman called upon the members for volunteer papers and discussions.

TRACY, of Mississippi, outlined a plan for the *botanical exhibit at the Columbian Exposition.* Various subjects have already been assigned to specialists, and station workers in botany are requested to suggest other lines of investigation they are engaged upon than those included in the subjects already apportioned. Each one should estimate the amount of space his exhibit would require. The Department of Agriculture will probably provide uniform labels and probably also uniform size and quality of sheets for mounting specimens. Botanists have shown great interest in undertaking the work. Considerable discussion followed in reference to the proper place for the exhibit of fungicides and spraying machinery. The general sentiment seemed to be in favor of a combined exhibit of fungicides and insecticides and machinery, by the botanists, horticulturists, entomologists, and agri-

culturists. On motion of Mr. Tracy the following resolution was adopted.

Resolved, that the botanical section call the attention of the various heads of the entomological, horticultural, and agricultural sections to the desirability of a collective exhibit of fungicides, insecticides, and apparatus in a single alcove.

ALWOOD, Virginia, made some remarks upon a recent severe attack of *a fungus disease upon apple leaves* in certain orchards in Virginia. Many trees lost 50–75 per cent. of their leaves, and the growth was greatly interfered with, the old orchard at the college being nearly defoliated. He exhibited specimens of the diseased leaves. It has increased in severity during three years. The life history of the fungus has not been studied, but the speaker claimed to have checked the progress of the disease by the use of a weak preparation of the Bordeaux mixture.

BREWER, Connecticut, exhibited some *English walnuts* grown by a friend from seed planted several years ago, also a butternut said to be borne on one of the trees coming from the same seed. As no positive proof could be shown the speaker thought it more likely that the butternut tree appeared there accidentally.

GORMAN, Kentucky, presented (through the chairman) a paper entitled "*A bacterial disease of cabbages.*" A rotting of the cabbage heads was traced to the work of bacteria. Inoculations produced the disease in healthy cabbages. Hot weather and a humid atmosphere are necessary to the progress of the disease. Alwood stated that the same disease occurred in Virginia. Atkinson, Alabama, spoke of a similar disease of turnips at Auburn, in which the interior of the turnips rotted, leaving the outer surface compact. Halsted, N. J., called attention to the undesirability of planting successive crops of cabbages and turnips where *Plasmodiophora* was injurious and suggested that such might be the case with this bacterial disease.

BRUNK, Maryland, spoke of the successful *treatment of Cladosporium fulvum* on tomatoes by using carbonate of copper 3 oz., carbonate of ammonia 1 ℔., with 50 gallons of water. This does not spot the fruit while the ammoniacal carbonate of copper does. The merits and demerits of the various spraying machines were discussed.

At the afternoon session ATKINSON, Alabama, presented notes on some *fungus diseases of the cotton plant*, and exhib-

ited a series of colored illustrations representing the external appearance of the plant affected by the different diseases.

ALWOOD, Virginia, made some remarks on the *artificial pollination of wheat.* He exhibited the varieties of wheat artificially pollinated and the resultant crosses. The method used in the experiments was described in detail.

CRANDALL, Colorado, exhibited the *fruit of the wild service berry* (Amelanchier alnifolia), and spoke of attempts being made to domesticate the fruit.

On the 14th the section was called to order by the chairman at 2:30 P. M.

Officers were elected for the ensuing year: GEO. F. ATKINSON, Alabama, Chairman; L. H. PAMMEL, Iowa, Secretary.

PAMMEL, Iowa, presented some notes on *a destructive disease of the cherry*, caused by a Cladosporium. The damage amounted to 25 per cent. The disease is also common on wild plums.

An informal discussion followed upon the germination of seeds of Vaccinium; the distribution of plants as governed by character of soil, heat, moisture, etc.

HALSTED, New Jersey, presented *Notes upon Monilia fructigena and spore germination.*—This cherry fungus was collected upon excrescences of a wild plum, caused by *Taphrina Pruni*, in Mississippi, and cherries were inoculated with it. These became badly diseased, while the checks remained sound. Inoculation showed that the fungus would grow also upon green and ripe tomatoes, and other vegetable substances, though not so well as upon cherries. The action of fungicides was tested upon spore germination, the cultures being attempted in concave ground slides. A piece of metallic copper foil, thoroughly scoured, as large as the end of a lead pencil, was placed in the bottom of the cell in the water. The spores failed to germinate in presence of this copper foil. Tests were also made with ammoniacal carbonate of copper compound of various strengths, beginning with the strongest, i. e., three ounces of carbonate of copper to one quart of ammonia. Spores were killed by this, also by the half, fifth and twentieth strength. Again one part of the fungicide of vineyard strength was added to ninety-nine parts water. Spores failed

to germinate in this, but when washed with pure water several times they germinated. These experiments suggest that perhaps fungi can be successfully combated with fungicides of far less strength than now employed.

BRIEFER ARTICLES.

Oligonema.—In my recent paper upon the new species of Mr. Pringle's last year's collection in Mexico I founded a new genus, *Oligonema*, upon a remarkable asteroid composite. I supposed that I had taken all possible pains to make sure that the name was not preoccupied, but I have since learned through the kindness of Mr. C. F. Peck that there is a genus of the same name among the *Myxomycetes*, established by Rostafinski. As it is necessary, therefore, to make a change, I propose to substitute the meaningless name *Golionema*, formed by simply changing the position of a single letter and in some degree suggestive of the original. The new species consequently becomes **Golionema heterophyllum.**—SERENO WATSON, *Cambridge, Massachusetts.*

EDITORIAL.

THOSE ARE not particularly difficult questions which Professor MacMillan asks in "Open Letters."

The only answer to the first is, "that depends." The answer is certainly not to be found in any cast-iron rules, though the inexperienced may fondly imagine so. If we understand the problems of nomenclature they require a judicial attitude on the part of the student. He has a code of laws—doubtless imperfect; doubtless capable of improvement by the application of the two decades of experience which has been acquired since they were framed—and by the principles set forth in this code he is to be guided. In addition to the code he is to use his common sense — if he has any — in determining what name is to stand. What were the use of the judge on the bench if he have no discretion in the interpretation, application or even suspension of the law in particular cases? To say that the laws of nomenclature are to be inflexible and of universal applicability is quite as absurd as to endeavor to make civil statutes so. It would be wonderfully convenient if this could be attained, even with the law of priority, but it seems quite impossible to secure rigidity without absurdity.

THE ANSWER to the second question, which seems to be addressed to the GAZETTE, is almost self-evident. *There is no self-constituted authority.* He only can be recognized as such whose knowledge and aptitude seem to his fellows to deserve the distinction. The judge does not make himself a judge; he is called to the bench by those who think him qualified to decide nice questions. The GAZETTE recognized Dr. Engelmann as an authority on the Cactaceæ of this country. Why? Not because he proclaimed himself such, but because he knew much about these plants through wide observation and exhaustive study, coupled with a special aptitude for exact and critical research. On a general question, such as that of nomenclature, we recognize as an authority the man who has had experience in untangling its knots, and who has shown himself judicious and accurate as well as acute. We distrust an attempt by a novice, even though he is using "his best bibliographic and analytic ability" to decide the questions of nomenclature which may be raised in a list of a thousand species. But the GAZETTE will warmly welcome the effort of these "young, misguided enthusiasts" to study questions of more limited scope — even questions of nomenclature in restricted groups of plants, provided they take proper pains and time in the study.

On the other hand, good intentions, independence, and a desire to do something are not enough. The now notorious "Farmer's-Alliance judge" in Kansas 'struggled along', 'doing the best he could', 'differed from an authority' (the Supreme Court), 'honestly' (no doubt), 'submitted his efforts to the test of time and the correction of wider and abler research,' and — made himself a laughing-stock for the country! So some botanists undertake a jurist's decisions without even legal training, and the result is quite as ludicrous.

CURRENT LITERATURE.

A Flora of Texas.

With the commencement of volume II, the contributions from the National Herbarium take on a new character. Hitherto we have had lists and catalogues of the plants of certain remote regions of our country, with here and there the descriptions of new species of plants; these have been valuable in their way, but in the present contribution we have not only everything a list would include, but in addition a complete manual, helpful alike to the botanical student who will find in it a guide and a stimulus, and to the older botanist who has hitherto

been obliged to search through *Plantæ Wrightianæ*, *Plantæ Lindheimerianæ*, *Plantæ Fendlerianæ* and dozens of other papers for the information which this work presents in compact form.[1]

The present publication covers the Polypetalæ and is the forerunner of others which will present our present knowledge of the Flora of Western Texas, of whose vegetation so much remains to be known. The National Herbarium deserves the praise of all botanists for undertaking such a valuable project for making known the flora of remote regions. When this area is completed there are other regions that equally demand attention before the flora of our domain is thoroughly made known. On the other hand the botanical students of Texas are laid under deep obligations to the National Herbarium for furnishing a manual of their flora, and ought to be stimulated in the collection of material and notes that will assist in clearing up many problems in distribution that the present work necessarily leaves open questions.

The name of the author is a sufficient guaranty of excellence in the arrangement of the work. We note with pleasure a few minor points which indicate a progressive spirit: (1) The use of the metric system for all measurements. (2) The adoption of certain changes in nomenclature, recognized almost everywhere as necessary. (3) The change of some ordinal names, as *Violarieæ*, *Caryophylleæ*, *Onagrarieæ*, etc.

Space will not permit as full statistics of the Texas flora as would be interesting. The following comparisons are given to show contrasts of distribution and the richness of the flora in question:

Orders.	Texan Flora.		Chapman's Flora So States.		Gray's Manual (*6th Ed.*)	
	Genera.	*Species.*	*Genera.*	*Species.*	*Genera.*	*Species*
Ranunculaceæ	7	21	11	54	22	76
Violarieæ	2	5	2	17	3	20
Malvaceæ	14	53	12	40	11	25
Leguminosæ	52	203	56	191	46	156
Onagrarieæ	6	38	8	45	7	44
Cucurbitaceæ	10	12	4	4	5	5
Cactaceæ	4	71	2	6	2	6

We shall await the completion of the work with great interest.—L. M. Underwood.

[1] Coulter, John M.—Manual of the Phanerogams and Pteridophytes of Western Texas: Polypetalæ. Contrib. from U. S. Nat. Herb. ii. no. 1. 8vo. pp. 152. pl. 1. Washington: Government Printing office. 1891.

Work from a productive laboratory.

THREE PAPERS have recently appeared in the series of "Contributions from the Cryptogamic Laboratory of Harvard University," and reprinted from *Proc. Amer. Acad.*, 26. No. XIV is entitled "Preliminary notes on the species of Doassansia," by William Albert Setchell. This genus, growing upon aquatic hosts, is separated from all the other Entylomata by having a sorus invested with a cortex of sterile cells. The twelve species, three of which are new, are arranged under three subgenera. Two new genera are described, both closely related to Entyloma and Doassansia. The one, *Burrillia*, dedicated to Prof. T. J. Burrill, has a compact, solid sorus with little or no cortex, and is found on leaves of Sagittaria; the other, *Cornuella*, dedicated to Prof. Maxime Cornu, has a hollow sorus with no cortex, and grows on Lemna.

No. XV is "On the structure and development of Choreocolax Polysiphoniæ," by Herbert Maule Richards, and contains a double plate. After describing fully the structure and development of this obscure alga which is parasitic upon the common alga, Polysiphonia fastigiata, the author discusses its relationship to the rest of the Florideæ. It has heretofore been placed among the Gelidiaceæ, but Mr. Richards finds that the condition of the cystocarp places the plant in the order Chætangiaceæ.

No. XVI is entitled "On a Kephir-like yeast found in the United States," by Charles L. Mix. "Kephir" is a fermented milk of the Caucasus Mountains, and the yeast which causes this alcoholic fermentation of milk has been known, so far, in no other place. What are known as "Kephir-grains" are added to the milk to produce the fermentation. These grains when fresh are white, compact, elastic masses, enveloped by a slime, with a spherical or elliptical contour, and varying from 1 mm. to 5 cm. in diameter. Drying does not deprive them of life, and in this dried state they are kept for long periods, becoming dirty brown and hard as stone. The origin of these grains seems to be unknown, no wild form of yeast having been found from which they might have been cultivated. They are said to grow in little clumps or granules on peculiar bushes found on the mountains just beneath the snow line. In 1881 Edouard Kern published the first account of the Caucasian "Kephir." The grains are composed of yeast cells and bacteria embedded in a zoöglœa mass. Exposed to unfavorable conditions the bacteria cells grow out into Leptothrix threads, with spore formation, and Kern named this Kephir bacterium Dispora Caucasica, a new genus and species. The recent study of Mr. Mix was suggested by the receipt by Dr. Farlow of two sets of specimens, one from On-

tario and the other from New Jersey, resembling the Kephir grains described by Kern. Mr. Mix has examined them thoroughly, both in their structure and effects on milk, and has come to the conclusion that they are the same as the Kephir grains of the Caucasus. The paper closes with a discussion of the theories of this Kephir fermentation.

Minor Notices.

DR. V. F. BROTHERUS AND TH. SÆLAN have published an enumeration of the mosses of the Kola peninsula of Lapland[1] together with a discussion of their distribution. The Kola peninsula lies between the White Sea and the Arctic Ocean, and is almost wholly north of the Arctic Circle. The enumeration of 309 species belonging to 72 genera indicates, therefore, a very rich moss-flora. The nomenclature follows Lindberg.

THE CHICAGO ACADEMY OF SCIENCES has been rather lethargic, but we are reminded of its existence by the recent publication of No. 1 of the Second Volume of its *Bulletin*. This is a "Flora of Cook Co., Ills., and a part of Lake Co., Ind.," by William K. Higley and Charles S. Raddin, and makes a pamphlet of 168 pages.

The list itself is preceded by a tribute to Henry Homes Babcock, who, twenty years ago, was Chicago's most indefatigable and zealous botanist, and the director of her ephemeral botanic garden. An account of the geology of Cook Co., and items regarding the forest trees, disappearance of species, localities of interest and statistics from the catalogue find a place in the introduction. The list includes 1336 species and varieties, of which 187 are introduced and the remainder native. The names used are those of Gray's Manual (6th ed.), with a few exceptions, though the authors "cannot entirely indorse the nomenclature." It is a pity that they did not use it throughout, since their use of it would not imply indorsement.

THE INVALUABLE "Host Index to the Fungi of the United States," by Dr. W. G. Farlow and A. B. Seymour is now completed by the publication of part III. (Cambridge, June, 1891). The present part contains the Endogens, Coniferæ, Cryptogams and Animals; followed by copious addenda, corrigenda and a full index. The 219 pages of the complete work represent an enormous amount of painstaking labor. We hope that the authors will have their reward in a large sale of the work. They may certainly take what reward there is in the consciousness of having done their fellow workers a most important service.

---

[1] Musci Lapponiæ Kolaënsis. Extract from Acta Soc. pro Fauna et Flora Fennica, VI. 8vo. pp. 100, with map. Helsingfors, 1890.

OPEN LETTERS.

What name shall be used? What is an authority?

If a worker in the botanical vineyard who has neither right nor claim to the title of "Systematic Botanist," may be permitted to ask a question concerning the proper nomenclature of seed-plants, perhaps a little illumination may be graciously let into his unsystematic brain-box by some of those who not only claim the title, but wear it right royally. The question is a brief one:

If we are not to use the oldest attainable specific name for a plant, what specific name are we to use?

Certainly we can not use the "oldest binomial," for our notions of a genus, and its inclusions are constantly changing. Nor is it particularly helpful to suggest that the name sanctioned by "authority" is the proper one, for after all—and I speak with bated breath, as one treading on holy ground—who *is* this "authority" anyhow? Is it the first worker in a group or the last? Is it the dead or the living? Is it this institution or is it that? Or is it the consensus of workers along some line? I, for one, have always supposed that attempts to constitute one's self, or one's descendants, or one's co-workers a botanical, zoological, geological or petrographical hierarchy was, to say the least, unscientific. If great groups of humble workers—such as those who gain a little cheap notoriety by trying as best they may to get together a local flora in which the results of their best bibliographical and analytic ability are collected—are to be decapitated at one fell blow, it is important to have it understood just why they are disposed of and just who volunteers to pull the guillotine-lever.

There is such a constantly increasing number of young, misguided enthusiasts among the group which we may for convenience call the "botanists of North America," that something more than reading the riot-act will be necessary to convince them that, after all is said, the temper of Charles Darwin is not a pretty fair one to try to imitate. Consequently they will doubtless continue to struggle along, doing the best they can, differing from "the authority" when they honestly have to differ, submitting their efforts to the test of time and the correction of wider and abler research, receiving honest criticism with what grace human nature permits and, withal, meaning no affront, personal or otherwise, to the authorities with whom they cheaply differ.

On the whole this second question troubles the writer as well as the first. An answer is respectfully asked. "What *is* an authority?"—CONWAY MACMILLAN, *University of Minnesota.*

NOTES AND NEWS.

HENRI JUMELLE has, by three distinct lines of proof, shown that when in the light the absence of CO_2 accelerates the transpiration of green parts of plants, this acceleration is due to the fact that the energy of the rays absorbed by the chlorophyll is not employed for the decomposition of CO_2, but operates entirely in increasing transpiration.

PROFESSOR BYRON D. HALSTED has been elected secretary of Section F. of the A. A. A. S., for the meeting to be held next August in Rochester, N. Y.

MESSRS. F. H. KNOWLTON and THEO. HOLM, of the U. S. National Museum, sailed for Europe early this month for a two months visit both for science and pleasure.

A RESOLUTION recommending the establishment of a National Arboretum at Washington was approved by the Botanical Club, Section F, and the general Association.

DR. J. M. MACFARLANE, assistant in botany in the University of Edinburgh, was made welcome by the American botanists at the Washington meeting, and took an active part in the proceedings.

MR. THOMAS MEEHAN has found cleistogamous flowers in abundance on *Polygonum acre* and suspects the same habit in other species. He expects to make this the topic of a note in the Proceedings of the Philadelphia Academy.

PROFESSOR ANDREA KROSSNOFF, of the University of Charkoff, S. Russia, was present at the botanical meetings of the Association, and desired to make arrangements for the exchange of plants of the Caucasus and other Russian districts for the plants of central and western N. America.

THE BOTANICAL papers at Washington were so numerous that many well known botanists, who had intended to read, presented no papers. The feeling was strong in favor of a separate Section of Botany, and notice of an amendment to that effect was given, to be acted upon at the next meeting of the Association.

MR. O. F. COOK, instructor in biology at Syracuse University, is at the head of an expedition, to Liberia and other parts of Africa, which is to sail about Nov. 1. The object of the expedition is to study the natural history of the country, especially the plants and insects. Mr. Cook will be glad to hear from any persons who would like material from that region.

DR. C. F. MILLSPAUGH, Morgantown, W. Va., will issue a preliminary catalogue of the Flora of West Virginia the coming winter; with his own work in the State he is desirous of compiling that of others as fully as possible. Any botanists who have worked in the State, and who will send a list of species they noted there, giving localities, will receive full credit, and six copies of the Flora as return for the kindness.

MR. T. KING, of Wellington, New Zealand, who was formerly conservator of the state forests on those islands, is preparing sets of New Zealand plants of from 500 to 1000 species, which he will dispose of at $4.50 per hundred. Mr. King is the most prominent botanist of New Zealand, and author of "The Forest Flora of N. Z." and of a "Student's Manual of the Flora of N. Z." This is a good opportunity for any who may wish to secure plants from that region.

E. AUBERT finds a simultaneous evolution of O and CO_2 in certain Cactaceæ when the illumination is of moderate intensity and the tem-

perature high (35° C.) The explanation seems to be that the respiration of the tissues is sufficiently active to produce more CO_2 than can be assimilated by the superficial chlorophyllous tissue. When the temperature is reduced to 10°–15°, or when the intensity of the light is increased, the CO_2 is not recognizable.— Cf. *Compt. Rend.* 112. 674.

BRAZIL IS to have an Agricultural and Mechanical College. A syndicate of capitalists has already secured a fund of $200,000 for its endowment, and the state and general governments will aid it. It is to be located in Sao Paulo, under the Tropic of Capricorn, in the best part of the Republic. Its promoters expect to make it the largest institution of the kind in existence. Professor L. H. Bailey has been tendered the presidency. The offer is a very flattering one, not only in a financial way, but also in the opportunity for work in a splendid flora.

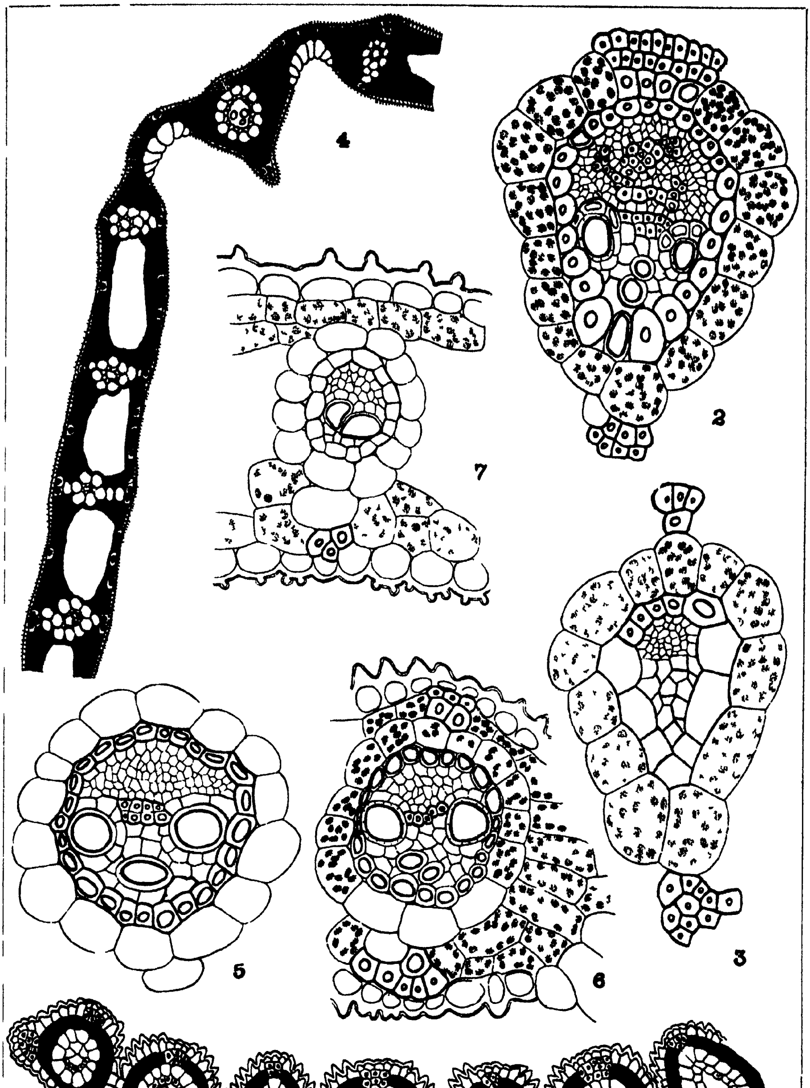
A USEFUL SOUVENIR was presented to the botanists by the Forestry Division of the Department of Agriculture. It contained a list of the trees to be found in the various parks of Washington with maps that serve as a complete direction. The souvenir is a curiosity in the matter of synonymy; containing also the description of a new species, a single specimen of which is now growing on the grounds of the Agricultural Department, but whose nativity no one knows, it furthermore raises the question whether describing a plant in a souvenir is publication.

IN CONNECTION with Dr. Halsted's note (p. 266) on the influence of copper salts on germination, a recent paper of O. Loew [1] on the poisonous action of distilled water is of interest. Such an action has been observed in the case of several Algæ, notably Spirogyra. Nägeli determined that this was due to the traces (1 : 10,000,000) of copper derived from the distillation apparatus and presumably dissolved as carbonate. The poisonous action is not exerted by water distilled in glass vessels, nor after the distillation of the first 25 liter seven from metal apparatus.

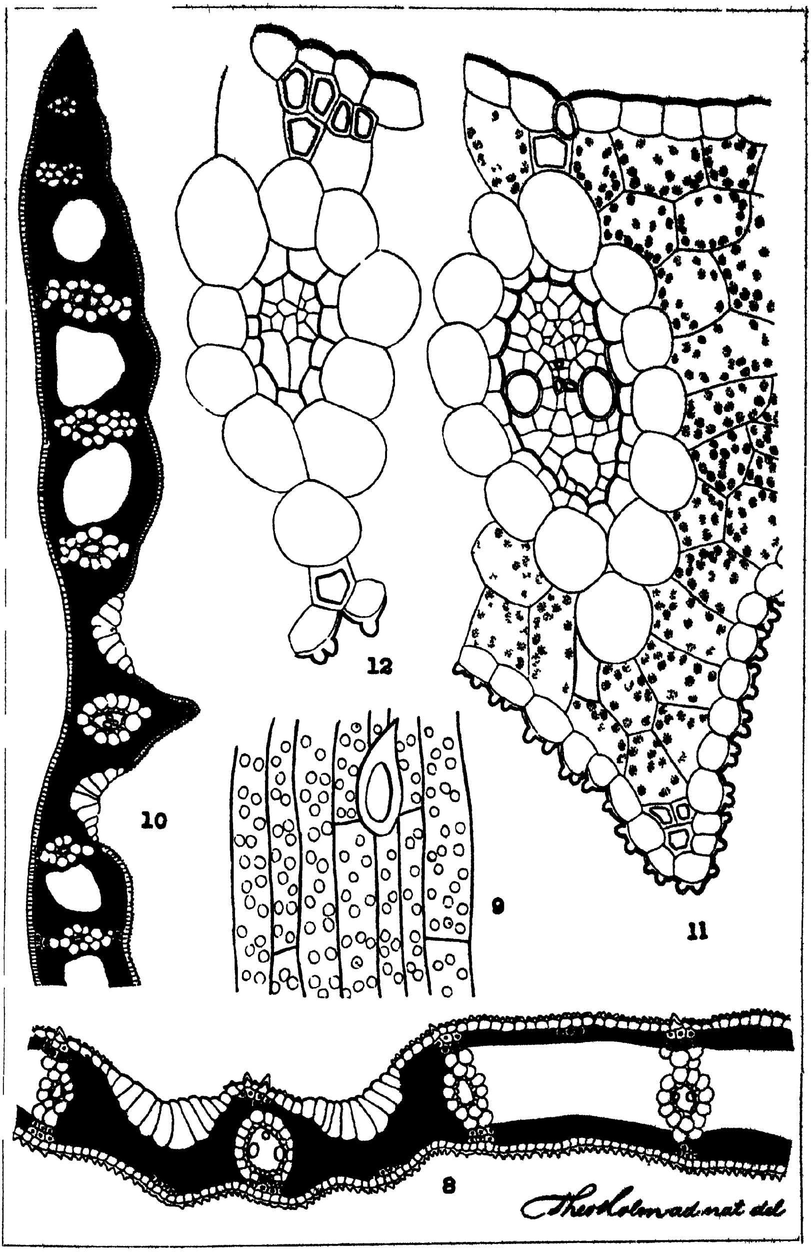
PROFESSOR R. PIROTTA is writing a monograph of *Keteleeria Fortunei* Carr., a monotypic Conifer. In a preliminary note [2] he shows that the primary root is diarchous and contains a large pith, in the middle of which is a resiniferous duct of considerable size; similar ducts are also irregularly scattered in the secondary wood; besides that the secondary bark shows several mucilage-cells (*idioblasti mucipari*). In contrast to the root, the stem has resiniferons ducts and mucilage-cells in its primary bark and wood, but none in the secondary. The leaves have only stomates on their inferior face. The mesophyll shows three zones: a palisade-tissue of two rows of perpendicular cells, a pneumatic tissue of about three rows of rather irregular cells, which form large lacunes, and finally an uncolored conductive tissue, surrounding the fibro-vasal bundles. Two resiniferous ducts and some very large, roundish mucilage-cells were observed in the leaves, especially distinct in tangential or longitudinal sections.— T. H.

---

[1] Landw. Jahrb. 20. 235. (1891).
[2] Annuario del R. Instituto botanico di Roma, anno IV, 1891.



HOLM on DISTICHLIS and PLEUROPOGON.



HOLM on DISTICHLIS and PLEUROPOGON

A study of some anatomical characters of North American Gramineæ. III.

THEO. HOLM.

Distichlis and Pleuropogon.

(WITH PLATES XXIII AND XXIV.)

Distichlis maritima Rafinesque.— While engaged in studying the leaf-structure of *Uniola Palmeri* Vasey, I was well aware of the great similarity that exists between this species and the genus Distichlis in external characters of the inflorescence, the rhizome, and the rigid, densely 2-ranked, involute leaves. Now having examined the anatomy of the leaf of a number of specimens of Distichlis, the similarity between these two plants has been found to be so striking that it seems most natural to consider Uniola Palmeri as a true Distichlis. Professor F. Lamson-Scribner has also informed me that on seeing the plant, he immediately took it for a Distichlis and was unable to distinguish it from this genus.

In studying the leaf-structure of Distichlis maritima, several male and female individuals have been examined from different parts of North America, and although the structure is essentially the same, a few differences have been observed. If we take the entire structure of the leaf into consideration and compare it with that of the so-called Uniola Palmeri, described in the preceding paper, it will be difficult to find any essential difference. We may take for comparison the leaf of a female plant of D. maritima from western Texas of which a transverse section is figured on plate XXIII, fig. 1.

The epidermis of both faces shows the same structure as described for the superior face of Uniola Palmeri, having numerous warts and rather pointed epidermal expansions. The structure of the mestome-bundles is exactly the same and the development of these as well as their distribution accords perfectly with what we have seen in U. Palmeri, viz.: a thin-walled and green proper parenchyma-sheath, surrounding, at least in the largest bundles, a closed ring of very thick-walled parenchyma. Furthermore the leptome and hadrome are often separated by a layer of similar parenchyma, and

groups of very thick-walled leptome-parenchyma are also observable in the strongest bundles. The stereome, the mesophyll and the uncolored parenchyma agree entirely with that of U. Palmeri. The leaf structure of a series of specimens of D. maritima, male and female, but from widely separated localities is here compared:

Arizona, ♀: The stereome is rather weakly developed and the blade is relatively broader.—California, ♀: Agrees in all details with the specimen from western Texas, described above.—New Jersey, ♀: Especially characterized by the very rough inferior face of the leaf, due to numerous warts. The stereome is very strongly developed above and below the mestome-bundles.—Montana, ♂: Differs from all the above mentioned female plants in having a closed ring of merely thin-walled parenchyma inside the proper sheath, and no thick-walled parenchyma either in the leptome or between this and the hadrome. The superior epidermis shows very long thorn-shaped and curved expansions.—Arizona, ♂: The superior epidermis shows short, thorn-shaped expansions, and long hairs, especially towards the base of the blade, situated among the bulliform cells. The inferior epidermis is on the contrary nearly smooth and without any hairs. The mestome-bundles show the same structure as described above for the female specimen, and the groups of stereome are strongly marked.—Washington, ♂: Both faces of the leaf are very rough, and the stereome shows an exceedingly strong development. There is a closed ring of very thick-walled parenchyma inside the proper sheath of the largest mestome-bundles, and the leptome is nearly divided into two separate groups by similar cells.—Vancouver Island, ♂: This specimen is well characterized from the preceding in having merely a horse-shoe-shaped layer of thick-walled parenchyma on the leptome side.—Montana, ♂ (alkaline soil): This specimen, compared with that described above from the same locality, but not from the same kind of soil, shows a remarkable difference in having a layer of very thick-walled parenchyma inside the proper sheath. Groups of similar cells are scattered in the leptome and a layer separating it from the hadrome. The superior epidermis has warts, but no long thorns, and the inferior one is nearly smooth with only a few projecting warts.

D. maritima Raf., var. *stricta*, ♂ from Nebraska: This form is especially characterized anatomically by the hairy and

rough epidermis of the superior face of the blade, where numerous thorn-shaped expansions are intermixed with conical warts. The stereome is rather strongly developed, while the mestome-bundles, the mesophyll, etc., agree with what has been mentioned above for the typical form.

D. maritima Raf., var. *laxa*, ♀ from Utah: The epidermis of the leaf is nearly smooth on both faces, being destitute of hairs and thorn-shaped expansions; otherwise it agrees perfectly with the preceding variety.

D. thalassica Humb. et Kth., ♂ from Lower California: The leaf of this species shows the same structure in most details as the preceding D. maritima. It is, however, quite well characterized by the very rough epidermis, of which that of the superior face shows several sharp-pointed expansions, while that of the inferior face has numerous conical warts. The largest mestome-bundles have a closed ring of thick-walled parenchyma inside the proper sheath, and the leptome contains groups of similar cells, by which it is also separated from the hadrome. The stereome represents groups of considerable size above and below the largest mestome-bundles, but is entirely wanting below the smallest ones.

D. prostrata Benth., ♂ from Mexico: The leaves are rough above, hairy below and along the margins; the epidermal expansions of the superior face are thorn-shaped, while those of the inferior are merely warts or soft hairs. The mestome-parenchyma does not show such thick-walled cells as described for the preceding species, and the leptome is but imperfectly separated from the hadrome. As to the stereome, this forms merely small groups above and below the strongest mestome-bundles, and the uncolored parenchyma is only represented by small groups between the bulliform cells and the inferior epidermis. Considered altogether the anatomical structure of the leaf in the genus Distichlis is very uniform, and it does not seem possible to give any special characters, by which either the varieties or the supposed species thalassica and prostrata may be distinguished from the species maritima; because we have seen that male and female specimens of this last show variations among themselves nearly equivalent with the differences in the two varieties and subspecies.

Of the genus *Pleuropogon*, which is closely related to Uniola and Distichlis, three species are known. Two of these, *P. refractum* Gr. and *P. Californicum* (Nees), are inhabitants of

California, while the third one, *P. Sabinei* R. Brown, is a high arctic type. Specimens of this were collected at Cape York in northwestern Greenland by the Swedish paleontologist Nathorst, who has kindly furnished me with several finely preserved individuals.

The leaf structure shows in these species a rather uniform aspect, which strikingly indicates their occurrence in wet meadows, although they live under such widely different climatological conditions. Very characteristic are the large lacunes in the mesophyll, the merely two groups of bulliform-cells in the carene, and the proportionally weak development of the stereome.

Pleuropogon refractum Gr.—The epidermis cells are rectangular with nearly straight and rather thin walls and there are on both faces of the leaf numerous conical warts. The superior face shows also several thick-walled and sharp-pointed expansions, which are directed upwards and which form long lines above the stereome-bundles (plate XXIV, fig. 9). Stomates are present on both faces of the leaf and are partly surmounted by conical warts. The bulliform cells form two groups, one at each side of the midrib; they are large and their exterior walls are entirely smooth in contrast to the other cells of the epidermis (plate XXIV, fig. 8).

The mestome-bundles represent two degrees of development; the median one (plate XXIII, fig. 6) is the largest in the whole blade and forms a slightly prominent carene. It is surrounded by a thin-walled parenchyma-sheath of which a part contains chlorophyll. Inside this, the proper sheath, is also to be observed a true mestome-sheath, the cells of which are somewhat thickened. The leptome is separated from the hadrome by a single stratum of thick-walled mestome-parenchyma, and there is a small group of stereome above and below the entire bundle. As to the corresponding mestome-bundles in the lateral parts of the blade, these differ from the median one merely by having a few cells of uncolored parenchyma on both faces, so that the stereome is not here in contact with the parenchyma-sheath. A small mestome-bundle, representing the second degree, has been figured on plate XXIII, fig. 7, where is a completely uncolored parenchyma-sheath with a thin-walled mestome-sheath inside this. The leptome and hadrome are not so strongly developed as in the preceding and they are not separated from each other by

thick-walled parenchyma. The stereome shows here but small groups and is often wanting on the inferior face, below the leptome. The uncolored parenchyma consists here of one or two cells on the hadrome side.

Concerning the distribution of these two forms of mestome-bundles it may only be said, that the smallest ones are prevalent in the whole blade. As indicated above, the stereome is rather weakly developed, and forms groups corresponding to the mestome-bundles. There are, however, besides these groups some isolated ones (plate XXIV, fig. 8) opposite the bulliform cells, and also above the middle of the lacunes on the superior face, besides one at each of the two margins of the blade. The mesophyll is strongest in the middle part of the blade, where it forms one large group on each side of the midrib; in the lateral parts of the blade it is interrupted by the large lacunes, which extend from the one mestome-bundle to the next one. The uncolored parenchyma is in the mature leaf restricted to small groups, corresponding to the mestome-bundles, as described above.

Pleuropogon Californicum (Nees.)—Plate XXIII, fig. 4, a transverse section of the middle part of the blade, shows a remarkable difference from the preceding species. There is a sharp carene on the superior face, a structure undoubtedly very rare in the Gramineæ. Otherwise the section reminds one very much of that of P. refractum.

The epidermis of the superior face consists of rectangular, thin-walled cells with slightly undulated side-walls, especially above the nerves. Wart-shaped expansions are numerous, although wanting above the large bulliform cells, and there are also some lines of thorn-shaped expansions in this species above the nerves. The stomates, which are equally distributed on both faces of the blade, are surrounded, not surmounted as in the preceding species, by warts. The epidermis of the inferior face differs in the presence of dwarf-cells in alternation with longer, rectangular ones, all showing distinctly undulated side-walls. Epidermal expansions are on this face merely warts, which form longitudinal lines below the stereome-bundles or sometimes also between these.

As to the mestome-bundles, these are also here, representing two degrees, of which the first one may be described from the median (plate XXIII, fig. 5). The parenchyma-sheath is uncolored and thin-walled, bordered above and below by one or

two similar uncolored cells. There is a distinct mestome-sheath, the walls of which are especially thickened inwards. The leptome and hadrome are separated from each other by two strata of thick-walled parenchymatic cells. These large bundles are supported by groups of stereome above and below, which are separated from the parenchyma-sheath by a few uncolored cells, excepting in the median one, where the mesophyll forms an uninterrupted group above the entire bundle. The mestome bundles of second degree differ in size from those of first degree; besides which the mestome-sheath shows merely thin-walled cells, and the leptome is in immediate contact with the hadrome.

The stereome agrees very well with that of P. refractum, but the number of isolated groups is larger here, there being three groups opposite the bulliform cells, one below and about three above the lacunes. The mesophyll and the uncolored parenchyma correspond in most details with those of the preceding species.

Pleuropogon Sabinei R. Brown.—Epidermis of the superior face consists of thin-walled, rectangular cells with nearly straight side walls, and there are numerous conical warts. The stomates are restricted to this face and are surmounted by conical expansions of the surrounding epidermis cells. The inferior face of the blade is entirely smooth; the cells show strongly undulated side-walls and are nearly equal in size.

A transverse section of half of the blade shows about the same structure as in P. Californicum with the sharp keel on the superior face. The mestome-bundles are also nearly the same, but it must be remarked, that in this species the mestome-sheath is merely thin-walled in both forms of bundles; besides which the leptome and hadrome are but imperfectly separated in the largest ones by a few not very thick-walled parenchymatic cells.

The stereome shows in this species a still smaller development than has been observed in the two other species, and forms here merely two isolated groups in the margins of the blade. The mesophyll and the uncolored parenchyma agree in all the details with the corresponding tissues of P. Californicum.

Considering now these three species of Pleuropogon together, it is evident that they are, in spite of their great sim-

ilarity, easily distinguished from each other by the following anatomical characters, taken from the leaf-blade:

Epidermis.

Thorn-shaped expansions on the superior face	P. refractum. P. Californicum.
Epidermis of the inferior face perfectly smooth...........	P. Sabinei.
Epidermis of the inferior face with dwarf cells in alternation with long, rectangular ones.......................	P. Californicum.
Stomates present on both faces..........................	P. refractum. P. Californicum.
Stomates present merely on the superior face.............	P. Sabinei.
Stomates surmounted with warts	P. refractum. P. Sabinei.

Mestome-bundles.

Midrib forming a sharp carene on the superior face of the blade	P. Californicum P. Sabinei.
Mestome-sheath thick-walled in the largest bundles	P. refractum. P. Californicum.
Leptome and hadrome separated in the largest bundles....	P. refractum. P Californicum.
A few not very thick-walled cells between the leptome and hadrome of the largest bundles.......................	P Sabinei.

Mesophyll.

Forms two separate groups, one on each side of the midrib	P refractum.

Stereome.

One isolated group opposite each of the two groups of bulliform cells	P. refractum.
Three isolated groups opposite each of the two groups of bulliform cells...	P. Californicum.
One isolated group above each lacune....................	P. refractum.
One isolated group below and three above each lacune.....	P. Californicum.

Lacunes

Bordering on the parenchyma-sheath of the mestome-bundles	P. refractum.
Separated from the parenchyma-sheath by a small layer of mesophyll	P. Californicum. P. Sabinei.

U. S. National Museum, Washington, D. C.

EXPLANATION OF PLATES XXIII AND XXIV

Figs. 1–3, *Distichlis maritima*, ♀—Fig. 1. Transverse section of half of the leaf. The black part of the figure represents the mesophyll, × 75.—Fig. 2. Transverse section through the midrib, × 560.—Fig 3. Transverse section through a small mestome-bundle, × 560

Figs. 4–5. *Pleuropogon Californicum*—Fig 4 Transverse section of the middle part of the blade, × 75—Fig. 5 Transverse section through the midrib, × 560.

Figs. 6 9. *Pleuropogon refractum*—Fig. 6. Transverse section through midrib, × 560—Fig 7 Transverse section through small mestome-bundle, ×560.—Fig. 8. Transverse section of the middle part of the blade, ×75.—Fig. 9. Epidermis of the superior face, × 210

Figs. 10–12. *Pleuropogon Sabinei.*—Fig 10 Transverse section of half of blade, × 75.—Fig. 11. Transverse section through midrib, × 560.—Fig. 12. Transverse section through a small bundle, × 560.

On the structure and dimorphism of Hypocrea tuberiformis.

GEO. F. ATKINSON.

(WITH PLATE XXV)

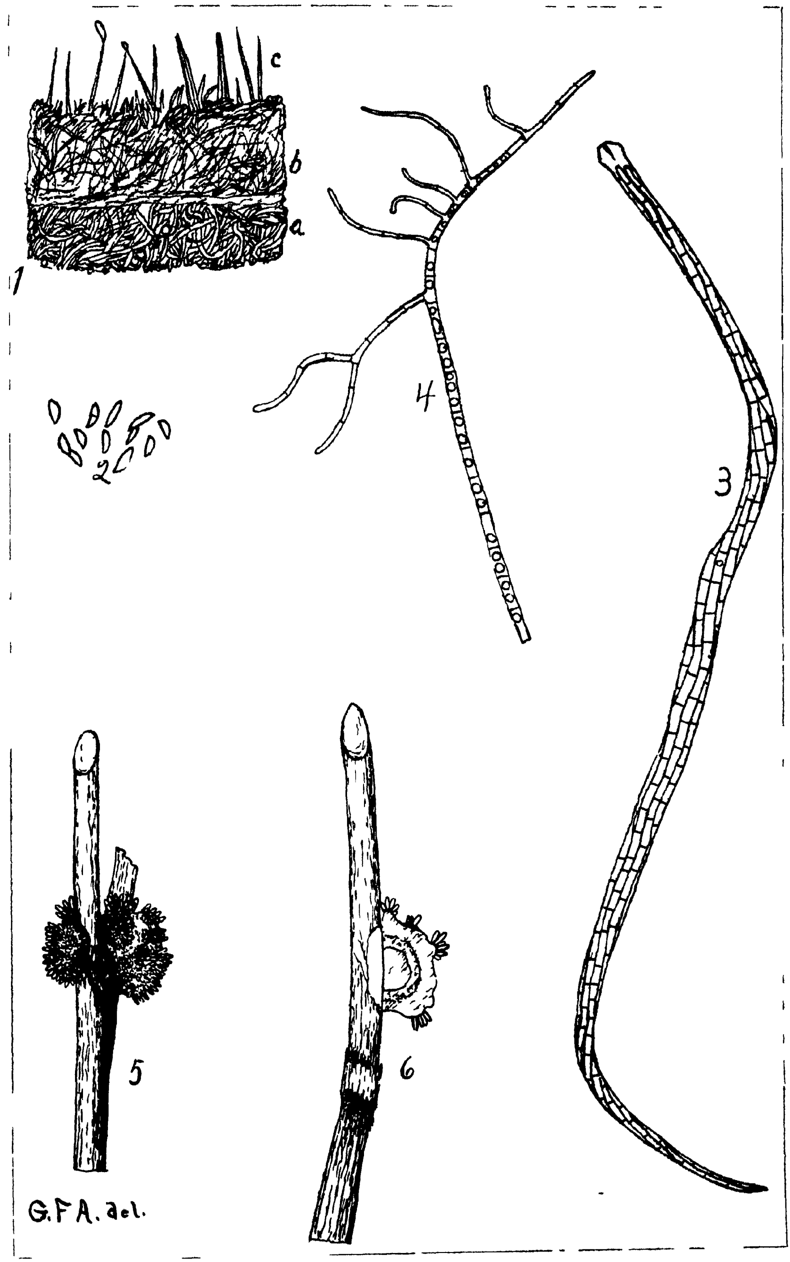
Hypocrea tuberiformis was described as follows by Berkeley in Grevillea IV, p. 13, from specimens collected by Ravenel in South Carolina: "Magna tuberiformis mycelio radiata albo affixa. On stems of *Arundinaria*. Car. Inf. Ravenel. No. 1220. Forming either a large mass ¾ of an inch across, or two or three distinct subglobose individuals, fixed to the stem by a radiating white rugose mycelium; at first yellowish, then black."

It was also distributed in Rav. F. Am. n. 733, and in Rav. Fung. Car. n. 52. Most of the specimens collected by Ravenel were probably sterile, since there is, to my knowledge, no published description of the forms of this dimorphic fungus.

Saccardo (Sylloge Fungorum II, p. 534) repeats Berkeley's description. Ellis and Everhart (Journal of Mycology II, p. 68) place it in the group of *Hypocreaceæ*, which constitutes Saccardo's genus *Hypocrella*, and add the following note, probably taken from specimens distributed by Ravenel: "Apparently the original specimens were imperfect and, as those in Rav. F. Am. are either young or sterile, we can only say that the perithecia are subcylindrical and stand on the stroma like the young horns of *Podisoma macropus*, about one millim. high."

Patouillard (Bull. de la Société Mycologique de France, VI, 2e fasc. pp. 107–9, 1890) describes a new genus of Hypocreaceæ under the name Dussiella. The perfect condition of the fungus he examined was deposited in the Berlin Museum and collected on stems of Arundinaria at Caracas, the conidial stage from specimens collected by Duss in Martinique. He considers these forms to be the conidial and ascosporous stages of *Hypocrea tuberiformis* B. & R., but unquestionably it is a very distinct fungus from the one described by Berkeley, from Ravenel's collection.

The perithecia are entirely immersed in the stroma, paraphyses are present, and while, as he states, the linear ascospores show its relationship to *Epichloe* and *Hypocrella*, the



ATKINSON on HYPOCREA

peculiar structure of the apex of the asci in *Epichloe* and *Hypocrella* is not present in his specimens, or at least not represented in the illustration. I first collected sterile forms of *Hypocrea tuberiformis* B. & R. on Arundinaria at Columbia, S. C., during the winter of 1888–1889. During the last two years I have collected at Auburn, Ala., its sphacelia and ascigerous stages.

STROMA.—The stroma is subglobose, entire, lobed, or divided, seated upon the reed or upon the leaf sheath and fastened by a whitish mycelium, consisting of radiating, undulate threads, which sometimes become tinged with yellowish brown. It consists of two different strata when young, composed of slender, compactly interwoven hyphæ. The outer stratum is quite opaque, as shown in section, and yellowish. It is connected with the inner white stratum by loose threads. The whole is of a leathery or corky consistence. When mature a section shows three differently colored strata; an inner layer, white, which is sometimes tinged with pink; an intermediate layer, light ochre; and an outer layer, cinnamon. The intermediate layer is not quite so compact as the outer two. After the stroma is dead it sometimes becomes black.

SPHACELIA STAGE.—The sphacelia stage occurs at Auburn, Ala., in late spring. I first collected it May 10, 1890. The conidiphores radiate from the surface, which they thickly cover, and are needle-shaped, tapering gradually to a sharp point where the conidia are borne. They measure 35–40μ long by 2–3μ at the base. The conidia are oval or broadly fusoid, inequilateral, hyaline, mostly continuous, but the larger ones sometimes faintly one-septate. Size, 3.5–4 × 7–10μ.

ASCIGEROUS STAGE.[1]—The perithecia are sessile, or only the rounded base immersed in the superficial part of the stroma. They are subcylindrical, a little broader in the middle than at each end, floccose, with loose white threads through which the cinnamon color shows. The apex is smooth and resembles the apex of *Epichloe typhina* (Pers.) Tul. The ostiolum is distinct. They are about 1 millimeter long by one-third of a millimeter in diameter, and stand on the stroma singly or in groups of 3–4–20, or crowded over a large portion. They are frequently branched, the bases of two, three or more being joined and the cavities confluent below.

[1]Mature in August and September

The asci are 8-spored, very large, varying from 450–750×14μ, tapering to a slender point at base, more gradually toward the truncated apex. They are very stout at the apex, somewhat like those of *Epichloe typhina* (Pers.) Tul. and *Hypocrella atramentosa* (B. & C.) the end being slightly enlarged, conoid and truncate.

The ascospores are linear, hyaline, pluriguttulate and pluriseptate, rounded at each end, at maturity separating at the septa and frequently germinating while yet within the perithecia, the germ tubes arising from any of the segments, sometimes before the sporidia separate at the septa. In most of the asci there is indication of a narrow slit through the apex, represented by a dark line, but I have never seen the spores escape through it. I have observed the same thing in the asci of *Epichloe typhina* (Pers.) Tul., but have not been able to determine positively whether it is a slit or only an opaque line.

We are able to see from this study the affinity of *Hypocrea tuberiformis*, B. & R., with Epichloe, since its only disagreement lies in the fact that the stroma of Epichloe, as characterized, entirely surrounds the stem of its host, while those agreeing in all essential parts of structure, but only partially surrounding their hosts, are provided for in Saccardo's genus Hypocrella. It thus frequently transpires that the genetic relationship of some forms is determined by fortuitous circumstances rather than by structural affinity.

Hypocrea atramentosa B. & C. might have been an *Epichloe* were it not for the fact that it appears too early in the season upon the opening buds of *Andropogon Virginicus.* These it first entirely embraces with its infant stroma, when later Andropogon rises, tears it asunder, bears it only upon the underside of the leaves in the cluster, and leaves it nothing but a Hypocrella! But, until a monographic study can be made of members of both genera, *Hypocrea tuberiformis*, B. & R. should read, *Hypocrella tuberiformis* (B. & R.) My specimens were collected on *Arundinaria macrosperma* Michx. var. *suffruticosa* Munro (*Arundinaria tecta* Muhl.)

I take this opportunity of noting the favor extended by Mr. B. T. Galloway, Chief of the Division of Vegetable Pathology, Washington, D. C., in allowing me the use of the Bull. de la Soc. Myc. de France, *tom. cit.* and Ravenel's two exsiccati,

Fung. Am. and Fung. Car. I find that n. 52 of the latter is a perfect condition of this fungus.

Department of Biology, Alabama Polytechnic Institute, Auburn, Ala.

EXPLANATION OF PLATE XXV.—*Hypocrella tuberiformis* (B. and R.) Atkinson Fig. 1, section of portion of young stroma, *a* inner layer; *b* outer layer. *c* conidiophores Fig. 2, conidia Fig 3, ascus with linear ascospores. Fig. 4, portion of ascospore germinating. Fig 5, perfect condition, stroma bearing perithecia. Fig. 6, section of stroma. Figures 5 and 6 are magnified about 1½ times, the other figures much more

Notes on the Flora of Canada.

JAMES M. MACOUN.

During the season of 1890 a considerable number of plants were discovered in various parts of Canada that were either new to the Dominion or were of sufficiently rare occurrence to be worthy of note. Except when otherwise mentioned all the plants in this list were collected by Prof. Macoun and myself in British Columbia. The asterisk (*) after the name of a plant signifies that it had not before been found in Canada.

1. Thalictrum Fendleri ENGELM.*—Very abundant in low grounds at Kicking Horse Lake, Rocky Mts.

2. Ranunculus hispidus MX. var. Oreganus GRAY.*—Low grounds at Sproat, on the Columbia River, 15 miles north of the International Boundary, and on the Kootenay river, about half way between Sproat and Kootenay lake, B. C.

3. Ranunculus hederaceus L.*—Marshes near New Harbour, Newfoundland. Collected by Rev. A. C. Waghorne in 1889 and 1890.

4. Isopyrum biternatum TORR. & GR.*—Abundant in the vicinity of London, Ontario. Collected by J. Dearness.

5. Delphinium simplex DOUGL.—Very abundant on rocky banks, about 2 miles above the junction of the Kootenay and Columbia rivers, B. C.

6. Papaver nudicaule L. var. arcticum, ELKAÑ.— One clump of about twenty specimens was found on the mountains at Kicking Horse Lake, Rocky Mts., at an elevation of 8,000 feet.

7. Cardamine bellidifolia L.— Three specimens of this minute species were found growing with *Draba alpina* in mud on the western slope of Avalanche Mt., Selkirk Mts., B. C., altitude 7,500 feet. Not collected in Canada since Drummond's time.

8. Arabis Macounii WATS.—A new Arabis that has been named as above by Dr. Watson, and has lately been described, grows in abundance on gravelly slopes, west of the Columbia River at Revelstoke, B. C.

9. Draba nivalis JACQ. var. elongata WATS.—A few specimens of this plant were collected on the mountains at Kicking Horse Lake last season, where it had been found in 1885, but not separated from *Draba stellata* Jacq., with which it was growing.

10. Thysanocarpus pusillus HOOK.—Gravelly slopes at Sproat, B. C. Not recorded from interior before.

11. Silene Macounii WATS.—Dr. Watson has recently separated this species from S. multicaulis, and all Rocky Mountain references in Macoun's Cat. of Can. Plants belong to this species. Not rare on the mountains at Rogers' Pass and Kicking Horse Lake.

12. Arenaria tenella NUTT.—On dry ground at Kamloops, B. C. Not collected before in interior.

13. Stellaria longipes GOLDIE, var. Edwardsii T. & G.—Not rare on mountains at Kicking Horse Lake, Rocky Mts. Not recorded before from western Canada.

14. Sidalcea malvæflora GRAY.—Common at Revelstoke, B. C. Not recorded before from interior.

15 Claytonia cordifolia WATS.*—Abundant in woods (5,000 feet alt.) at "Warm Springs," Kootenay Lake, B. C.

16. Trifolium involucratum WILLD.—Revelstoke, B. C. Not found in interior before.

17. Trifolium microcephalum PURSH.—Revelstoke and Sproat, B. C. Not found in interior before.

18. Fragaria Virginiana DUCH. var. Illinoensis GRAY.—The common form at Deer Park, Lower Arrow Lake and Toad Mt., B. C.

19. Epilobium clavatum TREL.—A few specimens were found on mountains at Kicking Horse Lake, at an altitude of 7,000 feet.

20. Peucedanum bicolor WATS.*— Hillsides at Sproat, B. C.

21. Zizia cordata KOCH.—Rare at Kicking Horse Lake, Rocky Mts. The western limit in Canada.

22. Ligusticum scopulorum GRAY.*—Specimens collected at Rogers' Pass, B. C., have been doubtfully referred here by Prof. Coulter.

23. Angelica Lyallii WATS.*—In subalpine woods at Sproat, B. C.

24. Cornus pubescens NUTT. var. Californica, C. & E.*—Common at Sproat and Revelstoke, B. C.

25. Aplopappus Lyallii GRAY.*—With A. Brandegei on mountains at Kicking Horse Lake, altitude 8,000 feet.

26. Aster stenomeres GRAY.*—Amongst rocks on mountains at Sproat, B. C.

27. Antennaria luzuloides T. & G..—Deer Park, Lower Arrow Lake. Rare in Canada.

28. Gnaphalium decurrens SPRENG. var. Californicum GRAY.*—Rare at Revelstoke, B. C.

29. Hemizonella Durandi GRAY.*—On hillsides at Sproat, B. C.

30. Madia glomerata HOOK. —Revelstoke, B. C. Western limit in Canada.

31. Madia sativa MOL. var. racemosa GRAY.*—Near Sproat, B. C. Eastern limit in Canada.

32. Arnica Parryi GRAY.*—Mountain slopes at Kicking Horse Lake, Rocky Mts.

33. Arnica latifolia var. viscidula GRAY.*—Wooded slopes at Rogers' Pass, Selkirk Mts., B. C.

34. Arnica cordifolia var. eradiata GRAY.*—Woods at Deer Park, Lower Arrow Lake, B. C.

35. Microseris nutans GRAY.*—Common at Sproat, B. C.

36. Crepis runcinata T. & G.—Revelstoke, B. C. Western limit.

37. Heterocodon rariflorum NUTT.—Sproat, B. C. Eastern limit.

38. Micromeria Douglasii BENTH.—"Hot Springs," Kootenay Lake, B. C. Northern and Eastern limit in Canada.

39. Eriogonum niveum DOUGL.*—Lake Okanagon, B. C. Collected by J. McEvoy.

40. Asarum caudatum LINDL.—Revelstoke, B. C. Eastern limit in Canada.

41. Epipactis Helleborine CRANTZ.*—Near Lambton Mills, Ont. Collected by W. and O. White.

42. Epipactis gigantea DOUGL.—Deer Park, Lower Arrow Lake and "Hot Springs," Kootenay Lake, B. C. Rare in Canada.

43. Allium Nevii WATS.—Lytton, B. C. Collected by Jas. McEvoy. Only found before in Canada on Vancouver Island.

44. Potamogeton crispus L.*—Ashbridge's Bay, east of Toronto, Ont. Collected by Wm. Scott.

45. Carex Tolmiei BOOTT, var. nigella BAILEY.*—Mts. at Kicking Horse Lake, Rocky Mts.

46. Carex marcida BOOTT, var. debilis BAILEY.*—Kicking Horse Lake, Rocky Mts.

47. Agrostis geminata, TRIN.*— Rogers' Pass, Selkirk Mts.

48. Agrostis alpina.*—Rogers' Pass, Selkirk Mts., B. C.

49. Alopecurus geniculatus L. var. robustus VASEY, (n. var.) Kicking Horse Lake, Rocky Mts.

50. Deyeuxia glomerata VASEY, (n. sp.)—Kicking Horse Lake, Rocky Mts.

51. Deyeuxia Canadensis HOOK. var. occidentalis VASEY.* Kicking Horse Lake, Rocky Mts.

Ottawa, Canada.

What the station botanists are doing.

BYRON D. HALSTED.

The present season is one of unusual activity among station botanists. At the risk of repetition I record briefly the leading points obtained by the several workers and in the alphabetical order of their names:

ALWOOD, of Virginia, has demonstrated an effective treatment for a leaf blight of the apple and established the fact that weak Bordeaux preparations are as effective for grape rot as stronger ones. He has been successful in the artificial pollination of wheat.

ARTHUR, of Indiana, has shown that the water for killing smut spores in soaking wheat can be heated to a considerably higher temperature than heretofore thought safe, and that this treatment, while effective in destroying the smut spores, much increases the yield of the grain. He has shown that the copper sulphate method is effective with oats but detrimental to

the yield, and that the hot water method is equally effective. Results in the method of preparing seed potatoes have been obtained that may materially modify the customary ways of planting.

ATKINSON, of Alabama, has considered the fungous diseases of the cotton, describing some new species and recommending methods of treatment. He finds *Colletotrichum gossypii* South. on leaves and stems of cotton as well as the bolls; notes great injury to the fig by *Uredo Fici*, with suggestions as to spraying the tree to prevent it, and records for the first time in the United States the *Cercospora Bolleana* on leaves of the fig. He describes the nature of "Frenching" in cotton and shows that it is due to a fungus—a species of *Fusarium*. Critical notes have been published upon Erysipheæ of the Carolinas and Alabama, including the new species, *Microsphæra calocladophora* on *Quercus aquatica*.

BEAL, of Michigan, continues his experiments on grasses and clovers, that were planned several years ago.

BESSEY, of Nebraska, has investigated the natural forestry of the state and will soon publish the results. He is continuing his study of the forage problem of the plains.

BURRILL, of Illinois, has determined practical methods of exterminating Canada thistles. These pests do not seed in the rich prairie soil, but spread by rootstocks. Excellent results have been obtained with copper compounds as fungicides for grape rot, apple scab and potato blight. The latter is demonstrated to be a bacterial disease. A serious trouble of the blackberry and raspberry he has traced to the twig blight of pears (*Micrococcus amylovorus*). Studies are in progress upon several other bacterial diseases. *Puccinia rubigovera* has been found living over winter in the leaves of wheat and producing rust spores in early spring which grow upon the fresh foliage.

CHESTER, of Delaware, while confining himself almost exclusively to treatment of fungous diseases, has, in connection with the chemist, reached important conclusions as to the preparation of fungicides; e. g., in the use of carbonate of ammonia instead of aqua ammonia; the employment of glue and the use of a double hyposulphate of copper. It is now too early to report upon many field experiments. A study has been made of leaf spot of alfalfa, wheat scab, and rot of scarlet clover.

CRANDALL, of Colorado, is making a flora of the state, paying particular attention to the native grasses and fruits, and diseases of cultivated crops.

DETMERS, of Ohio, is studying the life history of the blackberry and raspberry, apple scab and potato blight, and the value of various fungicides. A state herbarium is being made.

DUDLEY, of New York, has found that the clover rust, prevalent from New England to the Sierras, is chiefly propagated in the uredo form, and is carried over the winter as mycelium. It was demonstrated that the æcidiospores produce uredo spots, and therefore the *Æcidium Trifolium-repentis* and *Uromyces Trifolii* are stages of the same species. The rust spores germinate best at a low temperature. As the second crop is most frequently infested, and as this is a valuable fertilizer, it often may be well to plow it under. The ordinary spores of the quince blight (*Entomosporium maculatum*) winter on the fallen leaves, not on the tree, so that germinating in early spring they infect the host directly. Therefore all leaves should be burned in autumn.

GARMAN, of Kentucky, shows that Bordeaux mixture and eau celeste will check the strawberry blight. Salt and lime may be used to prevent the growth of the broom rape, but will injure the host plant. Blue stone is satisfactory except its expensiveness. Hot water may be used to kill the broom rape seed, while doing no injury to, but rather benefiting, the hemp seed. Broom rape seed will retain its vitality in the soil for at least ten years. Anthracnose of the grape can be controlled by using blue stone 6½ lbs., lime 3½ lbs. to 22 gallons of water.

HALSTED, of New Jersey, is studying sweet potato and egg-plant diseases in particular, and looking after weeds in a general way.

HARVEY, of Maine, in his tests for germination of seeds, finds that a solution of corrosive sublimate of a proper strength to destroy the germs of mould, will injure the vitality of the treated seed. Fungicides and weeds are receiving attention.

HUMPHREY, of Massachusetts, has found the true pycnidial form of the black knot fungus, identified the "damping off" fungus with that causing the same trouble in Europe, added new facts concerning the scab of potatoes, the Peronosporeæ of the cucumber and the hibernation of cherry rot.

JONES (L. R.), of Vermont, during this his first year, is ex-

perimenting with fungicides upon potato rot, apple scab and rust, and oat and corn smut, but it is too soon for a report of results.

KELLERMAN, of Kansas, is moving to Ohio, but his work upon smuts and breeding of corn will remain as fine examples of his many important investigations beyond the Missouri.

LAMSON, of New Hampshire, writes that his work in the station for the year consists in collecting grasses, weeds and weed seeds, and of beginning in mycology and bacteriology.

MCCARTHY, of North Carolina, besides preparing a hundred page bulletin upon best agricultural grasses, has given much attention to field experiments with fungicides. The Burgundy mixture with soap is superior to the Bordeaux and the latter is improved by adding a small amount of glue. Seed testing is continued in co-operation with other stations.

MILL, of Alabama, has made a microscopic study of the cotton plant and is endeavoring to improve its fiber and seed by crossing. The effect upon lumber of tapping for rosin is being investigated. Wild grasses for grazing purposes and weeds are receiving attention.

SCRIBNER, of Tennessee, has a report ready for the press upon the grasses of the state. The work upon fungous diseases is being continued.

TRACY, of Mississippi, is engaged upon a flora of the state, is deeply interested in grasses and the blight of the tomato.

THAXTER, of Connecticut, it is with regret I note, has retired from distinctively station work, after doing excellent service in economic mycology. The results of his study of the onion smut, potato scab, apple rust and other fungous enemies, and means of controlling them, will be of permanent value. Dr. Sturgis succeeds him at New Haven.

BUCKHOUT, of Pennsylvania, and some others have a full load of college work.

BOLLEY, of North Dakota, and WOONTON, of New Mexico, are busy in their new fields

New Brunswick, N. J.

BRIEFER ARTICLES.

A neglected Spartina.— During the past two or three years I have received from Florida, Mississippi and Texas, specimens of a Spartina which I was at first disposed to consider new, but which I now think is *S. junciformis* ENGELM. & GRAY, described in the *Boston Journal of Natural History* v. (1845) p. 238. It is evidently the S. gracilis of Chapman's Flora, but not at all the true *S. gracilis* TRIN. (not Hooker), which is well described by Mr. Watson in the Botany of the Fortieth Parallel as having "4 to 10 spikes, mostly sessile and appressed to the rachis, with the glumes and lower palet (floral glume) ciliate-hispid on the keel." It is a species of the Rocky Mountain region and the Pacific coast. The S. junciformis seems to be confined to the Gulf region, and may be described as follows:

Culms stout, smooth, 3 to 4 feet high; leaves involute, those of the radical tufts 1 to 2 feet long, those of the culm 5 or 6, generally involute, rigid, narrow, smooth, the lower 1 foot long, the upper shorter; ligule a very short hairy fringe, lower sheaths mostly shorter than the internodes, the upper longer; panicle spike-like, 5 to 10 inches long, dense, often cylindrical, tapering at the apex, composed of 30 to 50 or more sessile, imbricated, appressed spikes or branches, which are from ½ inch to 1 inch long at the apex, the lower ones longer and less dense; spikelets 2½ to a little over 3 lines long, the upper empty glume a little longer than the floral glume, the lower one ¼ or ⅓ shorter, both hispid on the keel, both very shortly mucronate, or sometimes without the mucro; floral glume slightly hispid on the back, obtuse; palet smooth about equaling its glume.

Florida, *J. H. Simpson;* Mississippi, *Prof. S. M. Tracy;* Texas, *G. C. Nealley.* Probably confined to the vicinity of the Gulf of Mexico.

Prof. Scribner, to whom I sent specimens of this Spartina, states that the same was collected last year by Mr. Pringle in Mexico, and that he identified it as *S. densiflora* BRONG. which is a native of Chili. He also states that *S. Gouini* FOURN., Mex. Pl. Enum. Gram. p. 135, is apparently the same. It may be doubted whether the Chilian species is the same as our plant; perhaps only an inspection of specimens will enable us to determine; but if Fournier's plant is the same, his name must give place to that of Engelmann and Gray, as that was published many years earlier.— GEO. VASEY, *Dep't of Agriculture, Washington, D. C.*

EDITORIAL.

THE GENERAL ignorance regarding the essential processes of plant life is appalling. If one were to ask the persons he met in a walk what trees lived on and how they secured their food, the answers received would doubtless be more curious than edifying. It would probably be a safe venture to assert that not one college graduate in one hundred can give a clear statement of vegetable nutrition, assimilation and respiration. And yet the college graduate has doubtless had the best opportunity of any class of persons to become informed upon subjects like these. The fact is that some of the most generally interesting topics relating to plants, those which bring plants into a more intimate relation with animals as living, active beings, have not yet received due recognition from general educators, or even from botanical teachers themselves. No one can accuse American botanists of being slow or of lack of enthusiasm, but having been absorbed in assorting the rich material of the native flora, in working out the life histories of the lower forms, and in studying minute structures by the newly developed staining and embedding methods, there has seemed to be no room and time for the consideration of other topics. But no one who has watched the course of the science elsewhere, or even at home, can doubt that the day for physiology to be the dominant subject in American botanical thought is not far off. When that day arrives, we may expect it to be more absorbing and more revolutionary of previous ways of thinking, than any of the recent waves that have disturbed the even tenor of botanical progress. It is to be hoped, indeed, that, besides the changes which may be effected in the course of thought within the botanical domain, this wave may be sufficiently powerful to beat high upon the rock bound coast of popular ignorance. Such a change in sentiment might give the opportunity to establish a new set of ideas regarding matters of physiology.

CURRENT LITERATURE.

Recent Systematic Papers.

CONTRIBUTIONS FROM THE NATIONAL HERBARIUM.—The first volume of this series of contributions is continued by the appearance of no. 4, issued June 30, 1891. It is the work of Mr. J. N. Rose, Assistant Botanist, and treats of the collections of plants made by Dr. Edward Palmer, in 1890, in western Mexico and Arizona. The collection from Alamos and vicinity proved to be a very rich one, no less than 45 new

species being described in the paper. Ten of them are illustrated by full page or large folded plates. A new genus of Leguminosæ, *Willardia*, is proposed for a species that Dr. Watson referred doubtfully to Coursetia, as C. Mexicana. To give any notion of the nearly half a hundred new species is impossible in this brief review. The contribution, however, is creditable to the Division, and the chief Botanist deserves congratulation for the organization and promotion of this kind of work. There are some blemishes in matters of detail and a few marked inconsistencies between drawings and descriptions.

WATSON'S CONTRIBUTIONS.—Dr. Sereno Watson's "Contributions to American Botany, XVIII" is before us, appearing in Proceedings of American Academy, xxvi, 124–163. Part 1 contains the description of eight new species, chiefly from the United States, and a revision of the American species of Erythronium. Thirteen species of Erythronium are recognized, but one of which is new, although *E. mesochoreum* Knerr may be considered as such. Part 2 contains the descriptions of new Mexican species from the Pringle collections of 1889 and 1890. Among the 88 new species there described, two new genera appear, viz.: *Neopringlea*, to replace the preoccupied Llavea, a genus usually placed with the Celastraceæ, but whose affinities are shown to be in the Sapindaceæ; and *Oligonema* (now *Golionema*), a genus of homochromous Asteroideæ. Part 3 is concerned with a wild species of Zea from Mexico, described under the name *Z. canina*. At first thought to be the original wild state of our cultivated maize, Dr. Watson now considers it a distinct species. Part 4 contains some notes upon a collection of plants from the Island of Ascension, including three new species, a Rubus, an Asplenium, and a Nephrodium.

SUPPLEMENTING the above is Mr. B. L. Robinson's "Contribution from the Gray Herbarium," in the same volume of Proceedings of the American Academy, pp. 164–176. It contains descriptions of new plants from the Pringle collections of 1889 and 1890, twenty-six species, chiefly Gamopetalæ, being established.

PROF. F. LAMSON-SCRIBNER has just issued a paper (Proceedings of Philadelphia Academy, 1891, 292–309) treating of the Mexican grasses collected by Pringle in 1890, and also by an expedition in the same year from the Philadelphia Academy. Pringle's grasses number thirty-six species, three of which (Muhlenbergia) are new, although a good deal of synonymy is corrected. The paper contains a full page plate and two cuts in the text.

MR. THOS. MORONG has published notes on the North American Halorageæ which appear as a reprint from the *Bulletin of the Torrey Botanical Club*, 18, 229–246. Hippuris is made to contain three species.

Callitriche is credited with eleven, one of which, C. longipedunculata, is a new species from S. California. Proserpinaca includes two species; while Myriophyllum contains twelve. In the last genus M. ambiguum, var. limosum Nutt. becomes M. humile (Raf.), and M. scabratum Michx. becomes M. pinnatum (Walt.)

MR. A. P. MORGAN has issued the fourth paper in his series on North American Fungi, being a reprint from the *Journal of the Cincinnati Society of Natural History*, April, 1891. It treats of the genus Lycoperdon, which is made to contain thirty-one species, two of which are new. The paper is illustrated by two plates.

Minor Notices.

MR. J. S. CHAMBERLAIN has been making a comparative study of the styles of Compositæ. His paper containing 22 pp. and four plates, is issued as a reprint from the *Bulletin of the Torrey Botanical Club*, xviii, 175. Mr. Chamberlain concludes that while style characters are very useful in the classification of tribes, they cannot be relied upon entirely.

AN ENLARGED and greatly improved edition of Woolls' "Plants indigenous and naturalized in the neighborhood of Sydney" has just been issued. The plants are arranged according to the system of Baron F. von Mueller. The species of vascular plants number 1465, of which 175 are naturalized.

A VERY VALUABLE contribution to the literature of Geographical Botany is the paper just published by Mr. Warren Upham in *Proceedings of the Boston Society of Natural History*, 25, 140–172, entitled, "Geographic limits of species of plants in the basin of the Red River of the North." Mr. Upham's extensive investigations into the glaciology of that region, combined with his botanical training, have well fitted him to discuss the relation of plant distribution and migration to climate.

THE ANNUAL REPORT of the Geological Survey of Arkansas for 1888 has just appeared. Half of the report is devoted to a list of the plants of Arkansas, together with some general discussion of the state flora, by John C. Branner and F. V. Coville. The list does not pretend to speak of geographical distribution, but any fairly complete list of plants from Arkansas is of interest.

PROF. CONWAY MACMILLAN has distributed a reprint of his article in the *Revue général de Botanique*, on the European plants which have been introduced into the valley of Minnesota.

OPEN LETTERS.

Where is the home of Calypso?

I was much interested in Mr. Blanchard's notes on this dainty plant in the August number of this paper, for every botanist loves Calypso. If abundance of individuals is to determine the true home of the Calypso, then the Puget Sound region will easily bear the palm from northern Vermont. Fifty or one hundred specimens in half a day does not not seem at all impressive to me, for I have frequently gathered bouquets of several hundred in a few hours; and only two years ago I saw a boy selling bunches of 100 or more for ten cents, a fact which speaks more for the abundance of the plant than for proper local appreciation of its beauty. What is particularly interesting is that the habit of Calypso here seems to differ very decidedly from its habit in the east. The plant here never grows in Sphagnum bogs; indeed from my experience with it, I would nearly as soon look for it on exposed rock as in Sphagnum. I find it in rather dry and open coniferous woods, especially where the ground is covered with Hypnum Oreganum. It seems to have a decided preference for this moss and an almost equal antipathy to Hypnum splendens.

It would perhaps be better for Calypso did it grow here in Sphagnum, for its home in dry Hypnums renders it peculiarly subject to destruction by forest fires. I know of many places where a few years ago it was abundant, that will never again be brightened by its dainty slippers, all owing to fires. So I shall not be surprised if in a very few years the plant will be found more abundant in Vermont than it will be here.

I find that a large proportion of the plants here are fertile. The only insects I have seen on the flowers were ants, which were feeding on the nectar. I am inclined to believe that they are not the usual, if indeed at all, the fertilizers of Calypso.—CHAS. V. PIPER, *Seattle, Wash.*

Botanical Clubs in California.

A paragraph in the July GAZETTE mentions the organization of a botanical club in San Francisco. The beginning of this year witnessed the formation of two, one in Berkeley and one in San Francisco. The former dates from February 25, and is named the Chamisso Botanical Club, in memory of the distinguished botanist who visited the California shores in the early part of the century. It grew out of a purely spontaneous desire on the part of a number of post- and undergraduate students to engage in some work that would contribute to the knowledge of the California flora, and to this end they perfected an organization in which the professor of botany was in no way concerned and of which he was entirely ignorant until after the young society was fairly on its feet, and had mapped out for itself a special line of work. The members have been engaged in the accumulation of material for an annotated list of the plants growing within twenty miles of San Francisco, and have discovered many species new to the region and expect to "undiscover" a few that have been credited to this locality and do not grow here.

The other is the California Botanical Club, organized in San Francisco March 5, much more pretentious in point of membership, its roll bearing at last accounts one hundred and twenty-five names. On the list are the names of some well-known botanists of the Pacific Coast; but the majority are ladies who are interested in ferns and flowers. The club has a field of usefulness, in teaching and interesting in botany those who have leisure, and thus enlisting a larger number in the work of collecting and exploration—a work which is, in this state, only well begun.—WILLIS L. JEPSON, *Berkeley, Cal.*

NOTES AND NEWS.

PROFESSOR DR. GOEBEL has accepted a call to the University of Munich as Professor of Botany and Director of the Botanic Garden.

MR. ARTHUR LISTER, in *Journal of Botany* (Sept.), has published some notes on Mycetozoa, accompanied by four plates. The paper is a notice of the species not included in Dr. Cooke's "Myxomycetes of Great Britain," and contains the description of three new species.

THE HERBARIUM of the late Dr. C. C. Parry has now been arranged for sale, together with an extensive library of botanical works. A catalogue has been issued, which shows 6,780 species, represented by about 18,000 specimens. Of these 5,290 species are North American. Full information can be obtained from Mrs. E. R. Parry, Davenport, Iowa.

IN ANSWER to a request from the city council of Cleveland, Ohio, the U. S. Department of Agriculture detailed Prof. J. C. Arthur, as an agent of the Forestry Division, to examine into the causes of the injury and death of the shade trees of that city. His report ascribes the injury to the excessive quantities of coal smoke, more particularly to the noxious gases which accompany the smoke.

SPHÆROTHECA LANESTRIS Hark. has been supposed to be confined to California, and to a single host, *Quercus agrifolia*, but both the conidial and the mature forms have been found this season in Mississippi, by S. M. Tracy. It occurs on *Quercus prinus, alba, macrocarpa* and *falcata*, and is rather abundant. The conidial form has also been found in Alabama on Q. alba, by Mr. Geo. E. Atkinson.

FR. JOHOW, who has given much attention to phanerogamous parasites, proposes the following grouping for them, based upon habit: 1. euphytoid parasites, erect land plants, including five families with 35 genera and 400 species; 2. lianoid parasites, including the genus Cuscuta with 77 species and Cassytha with about 20; 3. epiphytoid parasites, tree-dwellers, including 500 Loranthaceæ and 15–18 antarctic Santalaceæ; 4. fungoid parasites, including about 60 species of the two families Balanophoreæ and Cytinaceæ.

AT A MEETING of the Royal Society of Canada, held May 29th last, a club was formed by the botanists present, to be known as the Botanical Club of Canada. It has no connection with the Royal Society other than that which all scientific and literary societies enjoy.

The object is to adopt means, by concerted local efforts and otherwise, to promote the exploration of the flora of every portion of British America, to publish complete lists of the same in local papers as the work goes on, and to have these lists collected and carefully examined in order to arrive at the correct knowledge of the precise character of the flora and its geographical distribution.

The method is to stimulate, with the least possible paraphernalia of constitution or rules, increased activity in the botanists in each locality, to create a corps of collecting botanists wherever there may be few or none at present, to encourage the formation of field clubs, to publish lists of local floras in the local press, etc., etc. Any person interested in the study of botany is eligible.

The general officers for the year are: Dr. George Lawson, of Halifax, president; A. H. MacKay, of Halifax, secretary and treasurer. There is also a secretary for each province, who will, in turn, appoint local secretaries in such localities as he may deem expedient. It is the duty of the local secretaries to stimulate botanical research in their districts, and to endeavor to secure such notes on occurrence and situation of specimens, as may eventually enable the club to publish a special catalogue of the flora of the region. We wish the new club success.

M. GUSTAVE CHAUVEAUD has investigated in great detail the non-articulated laticiferous tissue and the account of his study forms parts 1 and 2 of the *Annales des Sciences Naturelles*, Botanique, 7, xiv, pp. 160, 8 plates. The subject has long needed investigation. We translate his conclusions:

The continuous primitive laticiferous apparatus is formed by special initial cells which are the first elements of the embryo differentiated. These initial cells, rarely four, sometimes eight, frequently more numerous, are of constant number in each species. They appear always in the same transverse plane (the nodal plane), and are formed in most cases at the expense of the pericycle. They elongate into tubes and become much branched, constituting in the embryo a complex system often of great regularity. Later this system increases and furnishes the laticiferous system of the seedling and the adult plant. In case the plant acquires secondary formations, these formations are traversed by laticiferous tubes springing from the branches of the primitive laticiferous system near the generating layers. The appearance of new initial cells has not been observed after the first stages of embryonic development. The tubes do not show anastomoses nor transverse partitions. The branches in certain species are distributed through the pith as well as through the bark. Their terminations are not localized in a special tissue; they are found in the leaves and cotyledons either in the midst of the parenchyma or underneath the palisade cells or even more frequently in contact with the epidermis. In certain plants the continuous tubes seem to precede the appearance of the articulated tubes. Finally, they are not met with except in the Euphorbiaceæ, Urticaceæ, Apocynaceæ and Asclepiadaceæ, where they serve to characterize certain tribes.

VOL. XVI. NO. 11.—BOTANICAL GAZETTE.—NOV., 1891.

The sling-fruit of Cryptotænia Canadensis.

E. J. HILL.

While passing through the woods in the autumn of 1890 my attention was called to the rattling of seeds falling on the dry leaves which thickly covered the ground. Stopping to see from what plant they came it was found to be Cryptotænia Canadensis. Not knowing that there was anything peculiar in its structure, trials were made of several plants to learn by what contrivance a single one could throw its fruit all around it under the influence of a blow. By striking the stems near the base the fruit was scattered in all directions, some being thrown to a distance of five or six feet. The space on which it fell was somewhat elliptical in shape, the longer diameter being in the line of direction of the blow. It seemed a little paradoxical that a body, unless rebounding from a surface against which it had been thrown, should traverse the path over which the impulse came, but the fact that it did was not to be denied after repeated trials had shown it. Here was a phenomenon to be studied and an explanation found. It was evident that the behavior of the fruit was in some way connected with the elasticity of the stem and branches and its mode of attachment to them. This was about all that was determined on the spot, for the fruit broke away from its support so suddenly that the eye could not readily follow the motion. Almost simultaneous with the blow the sound of impact on the dry leaves was heard. Some plants were carefully gathered and placed in a vasculum to be taken home for study. The experiments then tried have been repeated the present season, and the conclusions reached at the time confirmed by numerous trials. The mechanism and operations by which the fruit is scattered are about as follows.

The mericarps of Cryptotænia when fully ripe split away from each other and hang from the two parts of the carpophore, which are separated above, like a versatile anther on its filament. The branches of the carpophore are flat and very slender. They curve over and are often bent a little

downward at the end by the weight of the carpels, which hang opposite to each other when in their normal position. At this stage in the process of ripening, the carpels have been detached from the carpophore for the greater part of their length, only a small part of it adhering at the extremity. To be completely detached it needs to be stripped up, for the loosening of the carpel takes place from below upward. But the adhesion at the top may be strong enough to turn the fruit over while released under the force of a sudden blow. So it will be slung from its support and propelled the lower end foremost. This end, being less tapering and rather heavier, will facilitate the process.

To illustrate my meaning by a pair of carpels, we will consider the blows as coming from the right hand. By the displacement of the stem to the left under this impulse, and its sudden stoppage when the limit of motion is reached, the energy imparted to the right hand carpel will cause it to turn over in order more easily to tear itself away and it will be thrown to the left of the plant. In some cases it may be jerked from its support and thrown somewhat to one side, being diverted from the line of direction of the blow by stronger adhesion to the carpophore and propelled with a diminished intensity. The left hand carpel may also be detached, particularly if the blow be violent, and thrown forward with the right, since more fruit is sent towards the point to which a blow tends than in the opposite direction. But it often remains attached, the arched and slender carpophore seeming to act like a spring to weaken the shock it would have received, and the carpel is carried forward with the stem on which it is supported, to return with it to the position of rest, or beyond, should the reaction be sufficient. The sudden stopping of the stem when the limit of motion is reached on the return will have an effect on the carpel like that in the former case, but in the opposite way, sending it to the right, or towards the point from which the blow tends.

The clue to this explanation was obtained by experimenting with plants held in one hand and snapping the branches bearing the umbels with the fingers of the other. While working in this way, one of the carpels flew from the stem held in front and a little to one side, and shooting by fell on a table back of my chair. It was heard to fall on some paper lying on the table, and was readily found. The distance from

where it was held to where it lay was nearly five feet, and, being quite close to the nearer edge of the table, it must have remained about where it dropped. The line of direction taken varied but slightly from that along which the blow was delivered. By spreading papers on the floor and experimenting when standing I have found the carpels lying eight feet back of the vertical in which the stem was held. This is a longer distance than would ordinarily be reached by fruit thrown from a plant at its common height.

The scattering of the fruit along the shorter radii of the elliptical area may be explained by the form of branching and inflorescence of the plant. There are several branches terminating in compound umbels, and the ultimate divisions of the stem in the rays of the umbellets are sufficiently numerous to point in all directions. By the principle of physics known as the composition and resolution of forces, resultants will be obtained from the application of a single force and the position of the carpels and their adhesion to the carpophore to coincide with numerous radii. But the distance to which a carpel may be thrown along these lines will necessarily be less than that coinciding with the longer diameter, for the length of a resultant is less than the sum of its components when forces act at an angle with each other, and their intensity is diminished. This, in connection with features previously announced, accounts for the shape of the area covered by the fruit.

Longitudinal sections of the branches of Cryptotænia show that it is well supplied with dotted and spiral ducts, the spiral being abundant. They are very long and numerous near the pith, and will contribute to the elasticity of the stem.

The only other way of accounting for the behavior of this plant in scattering its fruit appears to be that it acts like a bat and ball, the rays of the umbellets striking the carpels and knocking them off, either by their forward movement or on their return. But they seem too slender to have this effect on the relatively heavy fruit, the missile being considerably larger than the body striking it, and suspended in such a way as to receive the blow at the lower end alone. Still this may enter into the process and help in some cases. The mechanism of a missile attached to the end of a spring, or even rigid body, in such a manner as to be easily thrown off by its motion explains the action much more effectually. Here the

individual parts may be slender though the projectile is heavy, since the strain exerted by the force is distributed through a greater length, and is not so violent at a particular point. But the strain is very great when a ball is struck by the end of a bat, as would be the case with the rays of the umbellets, for the center of percussion, where a blow is most effective and where the strain is least, is considerably below the end of a body of nearly uniform thickness. But observation shows that the ends of the rays are not broken in the disengagement of the fruit.

Whether this mode of disseminating fruit is common among the Umbelliferæ is doubtful, because, if frequent, it probably would have been observed in other cases. However, more extensive observations on this point are needed before expressing a decided opinion. But as yet I have seen none that acts in the same manner. But the way in which the carpels split off from the carpophore and are suspended from it must in general facilitate the dispersion of the fruit of Umbelliferæ by shocks received from passing animals, and doubtless from gusts of wind, though not acting like a sling as in Cryptotænia. In an article by Hildebrand on this subject, mention is made of a single genus of Umbelliferæ, *Scandix*, in which the fruit is thrown from its support. But this is due to the tension to which the dry fruit is subjected when adhering to the carpophore, which causes it to be thrown to the right and left through its elasticity when released from stress, and is compared to that which occurs in *Erodium.*[1] This is the only case among the Umbelliferæ of fruits flying off by means of their elasticity cited in his more general treatise, "Die Verbreitungsmittel der Pflanzen," though several other modes of dispersion, with examples in illustration, are given for this family.[2]

Englewood, Chicago.

---

[1] Die Schleuderfrüchte und ihr im anatomischen Bau begründeter Mechanismus. (Jahrb. für wiss. Botanik, IX 270.)

[2] l. c. p. 140.

Bacteria of the Melons.[1]

BYRON D. HALSTED.

Early in July there were many complaints throughout the country that the melon, squash and cucumber vines were either not doing well or dying from some unknown cause. The first specimens to arrive were from Bangor, Me., followed by others from the central part of New Jersey, a locality famous for its production of cucurbitaceous fruits.

The attacked vines vary somewhat in their appearance, but generally there is a decay of the stem in proximity to the root, and then the whole plant wilts and fails to grow. Sometimes one or more leaves will fall to the ground and rot away before the balance of the plant is seemingly affected. This is particularly true of the cantaloups, while in the case of cucumbers the fruit may be the first to show the trouble. Here the half grown cucumbers exhibit from one to a dozen or more specks looking like "water cores," which increase in size, until the whole of the fruit becomes a rotten mass, the firm skin still holding the watery interior in shape.

A microscopic examination of the decaying stems, leaves and fruit showed that the decomposing tissues were teeming with bacteria. This was to be expected, but it remained to prove that these germs could be the primary agent in the decay. Inoculations of healthy fruits were made in the usual way by means of sterilized platinum wire taking the germs from the centre of freshly decaying cucumbers. It was found that with no other fungus present these germs were abundantly able to introduce a rapid decay into cucumbers, melons and squashes. Cucumbers seem to be the favorite, and in them the decay is the most rapid. It will run from one end to the other through the succulent centre of a four inch fruit in a single day. From the placentae the rot spreads towards the surface until all is a noisome pulp inclosed by the skin which may remain unbroken if the inoculation has been made at the stem end.

The next step in the study was the application of these germs to healthy plants in the field. This was done by means of a flamed glass tube one end of which had been drawn out into a long point. By means of this, the germs in liquid,

[1] Read before Section F, A. A. A. S., Washington meeting, August, 1891.

after being drawn into the tube, could be introduced into any part of the plant, even into the woody base of squash vines. When the inoculation was made near the end of a vine, the latter rotted away in from three to four days, and when nearer the base a longer time was required, but in all cases an ulcer was formed which spread more or less rapidly depending upon the tissue infected. In old stems the decay was almost entirely internal, and did not show much until the disease had spread through the pith to some distant soft parts. A medicine dropper was employed to place a charge in the middle of several petioles of large squash leaves. Upon the next visit, twenty-four hours after, all such leaves had fallen to the ground, and the portion of the petioles below the point of inoculation, six or more inches in some cases, were thoroughly decayed. In short, the bacterial disease first found in the cucumber and afterwards propagated from fruit to fruit in the laboratory, as also upon cut stems and petioles, is readily transmitted to vigorous living vines of the cucumber and squash in the field.

Sixteen seeds of summer crooked squash were divided into two equal lots, and each set of eight planted in a flower pot under a bell jar and in every way treated alike, except that the soil of one pot was watered at the beginning of the experiment with the juice of a cucumber which had decayed with bacteria. The eight seeds not receiving the bacterial liquid germinated quickly producing large, deep green plants, while in the other pot only two plants appeared above ground, and they were of a dwarfed, sickly, yellow color, and did not continue to grow. These two plants were quite close to the side of the pot and did not receive a full wetting by the bacterial water. The remaining six seeds when removed from the soil were decayed and noisome.

Eight seeds were next placed upon blotting paper, moistened with distilled water, and kept covered in a small artist's saucer, while a duplicate set were similarly placed, but wet with a solution containing bacteria from a decaying cucumber. Here again the untreated seeds all grew with usual vigor, while those in contact with the bacterial germs failed to germinate and soon decayed.

The pure virus was next introduced into the growing stems and green fruits of the tomato, and in both cases quickly produced a decay that caused the stems to fall and the fruit to

become a watery mass inclosed by the skin, similar to the cucumber from which the bacteria were taken for inoculation. At the time of the experiments some boxes of young tomato plants were close at hand, and into the centre of one of these a decaying cucumber was placed. In six hours some of the stems of the tomato plants six inches in height had rotted off close to the ground, where the liquid from the decaying fruit had come in contact with the young plants. In ten hours all the plants in the vicinity of the decaying cucumber were destroyed. Drops of the virus placed in the leaf axil of other plants quickly induced decay and death of the parts.

The virus from a cucumber was also used upon potato vines in the same manner as upon the squashes, but both the extreme age of the plants and the dry weather may have been unfavorable, as the decay was slow and comparatively harmless. Healthy tubers, however, when inoculated with the cucumber bacteria rotted with that rapidity characteristic of the bacterial decay of the potato. In all cases the tuber became of a pasty softness, and gave off a most unpleasant odor. This decaying substance when taken back to fresh fruit of the cucumbers continued to produce rapid decay.

Rutgers College, New Brunswick, N. J.

Interesting anatomical and physiological researches.

The leaves of aquatic monocotyledons.

M. Camille Sauvageau has just brought to a conclusion his noteworthy memoir[1] on the leaves of some aquatic monocotyledons. To the physiologist this contribution to a little known department of botanical science is no less interesting than to the morphologist. The studies of the author have been principally upon the *Potamogetonaceæ* (see Ascherson's monograph in Engler and Prantl: *Die natürlichen Pflanzenfamilien)*, and for the forty-eight species examined he announces that the histological characters of the leaf alone will be sufficient for identification. He finds, moreover, in *Zoste-*

[1] Ann. Sci. Nat., Botanique, 7. 13, pp 102–296, *Sur les feuilles de quelques monocotyledones aquatiques.*

ra, *Phyllospadix*, *Halodula* and *Potamogeton* that there is a remarkable water-pore at the apex of the leaf, formed by the disintegration of certain epidermal cells. This pore is in communication with the vascular system of the leaf and together with the ordinary stomata on the under surface facilitates the passage of a current of water through the whole organ. By means of immersing cut-off shoots of *Potamogeton*, etc., imbedded in the ends of bent thistle-tubes containing water and attached to a mercury pressure-guage, in jars of water, Sauvageau demonstrates experimentally the absorption of water by the leaves. He concludes that there are currents of water, comparable to the water-current of transpiration in land-plants, in the leaves of the *Potamogetonaceæ*, and that, when deprived of their roots, these plants may continue to live and prosper by absorbing water and salt-solutions through their leaves. Plasmolytic phenomena noted indicate that in these plants the absorption of water may take place over the whole surface of the leaf.

In general it may be said that these extremely able and careful investigations of Sauvageau go far to show that absorption of water is, in some cases, an "important normal function" of leaves. This has not yet been entirely clear, notwithstanding the well-known experiments of Mayer and Boussingault.—CONWAY MACMILLAN.

Structure of living protoplasm.

Probably the recent article by M. Fayod[1] upon this subject is as startling and difficult to reconcile with preconceived and accepted notions, as any physiological memoir that has appeared since the early days of karyokinesis literature. M. Fayod announces that protoplasm is not an emulsion, as it has lately been characterized by Bütschli and Quinke, nor is it a zoögloea-like by-product enclosing bacterioid *zell-granula*, as the Hartigs have indicated, nor a "complicated mixture" as Berthold somewhat indefinitely calls it. It is, on the contrary, a highly intricate network of spirally twisted, corkscrew-like, hollow fibrillæ, each possessing a hyaline wall negative to all staining reagents and capable of great dilation by the liquids or emulsions within. The nucleus is a peculiar knot of *spirofibrillæ*. The cell-wall possesses exactly the

[1] Rev. générale de Botan., May, 1891; *Structure du protoplasma vivant.*

same organization as the protoplasm. It is protoplasmic fibrillæ impregnated with cellulose. Certain obscure physiological problems are luminously explained under this view, viz., cell-growth, geotropism, ascension of sap, irritability in general, heliotropism, budding, and movements, such as those of amœbæ, plasmodia, bacteria and the diatoms. The method of M. Fayod—leaving aside the detail—is to inject bits of tissue with indigo, very finely powdered and in suspension. The preparation is dehydrated with alcohol after the usual method, and is examined in clove-oil. In this way it is possible to inject the spirally-twisted protoplasmic fibrillæ and thus expose them for examination and study. In seed-coat cells of *Cuphea* for example, the spirofibrillæ are found to have exactly the structure of a capillitium-fiber from certain *Trichias*—a genus of *Mycetozoa.*

This distinctly original view of protoplasmic constitution will, of course, need verification. It seems certain that peculiar spirally-twisted elements may be demonstrated in protoplasm by any one who follows Fayod's method, which is not a tedious one. The writer obtained results with epidermal cells from young *Pelargonium* leaves.

With the space at command, it is not possible to discuss fully the ingenious explanations which, under his conception of protoplasm, M. Fayod offers for the various physiological phenomena which present themselves to his notice. To most readers of his paper, however, it is certain that no page will be more interesting than the one on geotropism. Very simple, physical and mechanical laws suffice for the explanation of this *crux* of plant-physiologists. By the weight of liquids in the spirofibrillæ, under the action of gravity, longitudinal tension, in the cell-lining, is decreased and cell-formation takes place more readily along the line perpendicular to the surface of the earth. And the more gross materials will collect in the lower portions of fibrillæ and in the lower fibrillæ, leaving the finer, ethereal, easily dialysable substances uppermost, thus tending to inflate upper parts of fibrillæ and upper fibrillæ. Under such conditions of the mechanism, together with the variation of environment, nutritive rhythm, and changes periodic and constant in metabolic processes and products, Fayod finds little difficulty in explaining very clearly both geotropism and negative geotropism (*zenotropism,* turning toward the zenith). He quotes effectively the ex-

periments in aggregation of Drosera-protoplasm which have become classic, and notes the more recent results of Elfving and Wortmann who find that the protoplasmic layer is thicker on the *under* side of cells in a negatively geotropic (zenotropic) organ.

It is impossible to dismiss so carefully prepared and important a paper as this of Fayod with a shrug of the shoulders, as has been done, the author observes, with his earlier notes on the matter. Especially in view of the recent advances in karyokinesis study, as indicated in the researches of Watase, Guignard, Carnoy, Zacharias, Pfitzer, Strasburger and others, it is evident the older emulsion-theory of protoplasm is beset with grave difficulties. It is probable that even so admirable a work as Berthold's *Studien über Protoplasmamechanik* does not say the last word upon its subject-matter. Fayod's paper is an original and valuable contribution to the most fundamental question of both plant and animal physiology.—CONWAY MACMILLAN.

The relations of the phloem.

Within a few years our knowledge of the phloem region of the fibro-vascular bundles has been greatly extended. Not to go so far back as 1885, in which year appeared Hérail's Étude de la tige des Dicotylédons[1] in which the phloem received extensive consideration, we have last year Lamounette's extensive researches into the origin of the internal liber of the so-called "bicollateral" bundles.[2] Lamounette rejects the term "bicollateral" as did Herail, who considered it applicable only to the Cucurbitaceæ. In this terminology the internal phloem was looked upon as coordinate with the external phloem; whereas according to Lamounette (whose researches agree generally with those of Hérail where they touch common ground) the internal phloem is not developed from the procambium which produces the bundle, but arises from the pith parenchyma. It is not always easy to distinguish these two tissues, though in most cases this is easy because the internal phloem arises later than the xylem, so that the first formed spiral and annular vessels come to indicate the internal limits of the procambium before the internal phloem

[1] Annales d. Sci. Nat. Bot. VII. ii. 267.

[2] Annales d. Sci. Nat. Bot. VII. xi. p 193–278.

begins to develop. In the Cucurbitaceæ, however, the differentiation takes place at the same time, but even in this case Lamounette will not allow the applicability of the term "bicollateral." Every gradation in time of appearance is found between the Cucurbitaceæ and the Basellaceæ in which the appearance of the internal phloem is very late.

Lamounette investigated the hypocotyl, stem and cotyledons of a large number of plants by the aid of serial sections cut by the collodion method.

At the beginning of this year Leonhard published his researches into the anatomy of the Apocynaceæ[1] which show that the internal phloem occurs throughout this order, with possibly one exception.

In the August number of the Annals of Botany Scott and Brebner have an extended account of their studies as to the relation between the stem and root-structure in plants with bicollateral bundles and the special modifications of the stem-structure in plants which belong to this category. They adhere to the term bicollateral as a matter of convenience without expressing any opinion as to the order of development, and cite the term "vascular bundle," as a convenient expression not now generally representing a well-defined unit, but applied to vascular tissues even when the limits of the individual bundles cannot be traced. "So long as an internal phloem strand has the same longitudinal course as the neighboring bundles of the leaf-trace there is no serious objection to regarding them as parts of the same formation."

"Bicollaterality is a character widely prevalent among the most highly organized dicotyledonous families [18 are known] and of great systematic value. It may fairly be maintained that these orders represent in certain directions the most advanced types of dicotyledonous structure.

"The physiological importance of bicollaterality cannot be fully estimated until the general question of the functions of the phloem has been finally determined, but it is undoubtedly great. The sheltering of a portion, often the larger portion, of the delicate phloem within the woody cylinder is an obvious advantage, as is also the fuller utilization of the pith-area and the consequent concentration of the tissues generally. It is probable also that the pith-cells themselves may be able to discharge both storing and conducting functions more effi-

---

[1] Botanisches Centralblatt, xlv p 1.

ciently when brought into direct relation with the phloem and its proteid contents.

"In concluding we wish to point out the bearing of our subject on a theory which has recently been put forward as to the function of the phloem in general. In opposition to the prevailing view that the phloem is primarily a conducting tissue for the nitrogenous and especially for the proteid food-substances of the plant, Prof. Frank and Dr. Blass maintain that the phloem is essentially a store tissue for the benefit of the wood. (See this journal xv. 346.)

"We purposely avoid criticising Dr. Blass' arguments. . . . We willingly admit that in all plants with cambial growth, the supply of food materials for such growth must be an important function of the phloem. . . . But we wish to point out that the anatomical relations of the phloem are often quite inconsistent with the supposition that its principal or exclusive function is connected with the formation of wood.

"In all the numerous plants which have bicollateral bundles or an analogous arrangement of tissues, a great part of the phloem, often the greater part, and sometimes nearly the whole, is placed in that region of the stem where no formation of wood is going on, in a position as remote as possible from the wood-producing cambium, for the rare exceptions in which internal wood is formed may here be left out of consideration. Yet this internal phloem is absolutely typical in structure and contents. . . .

"So too with the phloem islands. In plants like Strychnos, these are no sooner formed than they become imbedded in dense wood, and are cut off from all direct communication with the cambium. It would be easy to cite other examples, as the stems of the Chenopodiaceæ and many other allied orders, in which almost all of the phloem is deeply imbedded in the fully-formed wood, or the monocotyledons generally, where the closed bundles retain a typical and active phloem for months and years after all formation of wood has been completed.

"In the light of facts such as these, we cannot but think that the view of Prof. Frank and Dr. Blass depends on too one-sided a consideration of typical dicotyledonous anatomy. . . . Our results as to the continuity of the various phloem-systems in root and stem tend to give further anatomical support to the theory of the conducting functions of

this tissue, a theory which, we need hardly point out, is fully consistent with the view of Prof. Sachs, that the phloem may also be the seat of proteid-formation."—R.

BRIEFER ARTICLES.

Pentstemon Haydeni, n. sp.—Of the *Genuini* group: a foot or two high, glabrous, the stems decumbent, simple or branching, very leafy: cauline leaves, linear-lanceolate to linear, entire, 3 to 5 inches long by 1 to 3 lines broad, sessile and clasping: inflorescence a compactly crowded thyrse, the floral bracts from ovate-lanceolate and long-acuminate to ovate and acute, nearly equaling or the lower much exceeding the flowers; peduncles none or short: calyx-lobes acuminate, 3 to 5 lines long: corolla an inch long or more, the throat broadly dilated and the limb nearly equally lobed: sterile filament, bearded near the summit: capsule equaling the calyx.

This plant was first collected by Dr. F. V. Hayden, in the Laramie mountains of Wyoming, during some one of his early surveys, without flowers or fruit, and was referred by Dr. Gray to *P. acuminatus* as a form with linear cauline leaves. It was rediscovered during the past season, in flower and fruit, by Mr. H. L. Webber, of the Shaw School of Botany, on the Dismal River in Thomas county, Nebraska, about a hundred miles west of the 100th meridian. It has nearly the habit of the more conspicuously cordate-bracted forms of *P. acuminatus*, but with an extreme of discrepancy between the cauline leaves and floral bracts. The flowers are much larger and the throat of the corolla more dilated.—SERENO WATSON, *Cambridge, Mass.*

A remarkable orange tree.—There is in the herbarium of Brown University a specimen which is something of a curiosity. It was sent us last spring by Mr. Rowland Hazard, one of our trustees, from Santa Barbara, Cal. I quote from his letter of transmission.

"It is an orange tree which for years has lived and borne fruit without bark for a space of over seven inches entirely round the tree. I first saw this tree in February, 1885. It had been injured by a fire about three years before. When I saw it first it had a number of ripe oranges on it and in March it bloomed and bore fruit in the fall. The trunk was in substantially the same condition as you now see it. There was a space just above the ground where there was no bark and the sap-wood had rotted away, leaving only the heart-wood as the

connection with the root. I bought the place on which the tree was, in 1885. The tree has borne and ripened oranges every year till 1890. In 1889 a sprout came up from the root. This proved to be a Chinese lemon on which the orange had been grafted. I was not here in 1889. When I arrived in the fall of 1890 I saw that shoots from the orange had been sent out the preceding spring but they had withered and died. The Chinese lemon was very thrifty and full of fruit. It evidently had taken the sap. The struggle was over and the orange was dead. I send you the whole of it with a part of the Chinese lemon shoot. I think it should be preserved, as it is proof positive of the circulation of sap through the heart-wood. It lived, blossomed and bore fruit every year for at least seven years, when there was no connection between the tree and the root, except the heart-wood."—W. WHITMAN BAILEY, *Brown University.*

Helianthus mollis.—Plants which I collected near Odin, Illinois, years ago, and plants from Tennesseee, sent by my friend, Dr. Gattinger, were blooming in my garden the past year. The Tennessee plants flower two weeks before the others, have involucral bracts double the length, and the leaves one-fourth broader, though no longer. The leaves of the Illinois plants are so thick that the nerves can scarcely be seen; the nerves of the other are strongly visible, and there are some other differences.

In these days variations of this character are scarcely worth special note. We find similar variations with any plant in areas of but a few acres in extent if carefully looked for.

In the Illinois plants I have noted that all the first flowers faced the southeast, the first day of opening. This season they all faced the northwest. I might settle the whole story by merely saying, "something in the environment must have influenced all these variations;" but to my mind the term "environment," so frequently used in connection with similar phenomena, is utterly meaningless. It is, however, clear that there are often separate lines of variation in widely separated localities. Sometimes I think we might solve the problem sooner if we were not so easily satisfied with the word "environment." THOMAS MEEHAN, *Germantown, Philadelphia.*

Further notes on the mutilation of flowers by insects.—In the GAZETTE for 1888, p. 39, I state that *Bombus pennsylvanicus* slits the corolla tube to obtain the nectar from *Physostegia Virginiana* and *Mertensia Virginica.* There was a mistake made in copying the name of the insect from the original notes; it should read *Xylocopa virginica*, the Virginia carpenter bee. Since the above mentioned note was pub-

lished I have repeatedly seen this bee visit these two species of plants, and in addition, the following: *Pentstemon pubescens, P. lævigatus, Pontederia cordata, Astragalus Canadensis,* and *Trifolium pratense.* It invariably, so far as my observation goes, slits the lower end of the corolla tube in order to reach the nectary. It is said to be the largest and most bulky of all known bees, the mouth parts being very highly organized. It appears to disdain to take its food in the usual slow fashion of other insects, but goes directly through the tissues to the nectary.

I have repeatedly observed the honey bee (*Apis mellifica* L.) visit all these plants, and it apparently prefers to take the nectar through the slits that have been made by the carpenter bee; but when it does not find a slit already made, it then goes to the mouth of the tube and visits the flower in the usual way, by entering at the mouth of the tube.

The common humble-bees are frequent visitors to all these, and many other flowers, but I have never seen them take the nectar in any other way than by the mouth of the corolla. *Bombus pennsylvanicus, B. americanorum* and *Apathus elatus* (the latter now thought to be the male of *B. americanorum*) are the only species which I have taken from flowers, and that have been certainly determined; but it is reasonable to conclude, from the strncture of their mouth-parts, that all the members of this genus take nectar in the same way.—JACOB SCHNECK, *Mt. Carmel, Ill.*

A new Ravenelia from Alabama.—In September, 1890, and during the autumn of 1891, the writer has collected at Auburn what proved to be an undescribed species of Ravenelia on *Cassia nictitans.* The species is remarkable for its great abundance on the stems and for the very long, fulvous pedicels of the teleutospores. It is characterized as follows:

Ravenelia Cassiæcola Atkinson, n. sp.—Caulicolous or hypophyllous. Sori on leaves one mm. or less, rotund or oblong; on stems oblong, irregular, confluent, sometimes covering space 1—10 cm. or more in length, frequently ambient, rupturing irregularly or longitudinally. Pseudo-peridium composed of closely cohering, irregularly angular, small cells, yellowish brown. Uredospores in mass appearing dirty yellowish white; singly, hyaline or dull yellow to fulvous, oval or rotund, minutely asperulate, $9–13 \times 12–16\ \mu$. Teleutospores in mass appearing black; singly, fulvous to dark brown; $30–100\ \mu$, convex at free end, depressed where joined to pedicel, small ones rotund, composed of from 5–30 cuneate cells, their free ends frequently bearing a single hyaline, short spine; cells $18–23 \times 20–30\ \mu$; cystoid cells 5–15, rotund, hyaline or colored, rigid, $14–18\ \mu$; pedicel fulvous, stout,

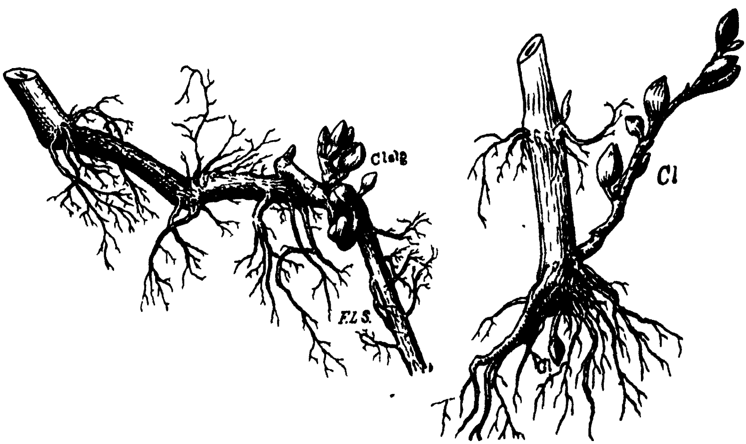
$50-80\ \mu$ long.— On stems, leaves and pods of Cassia nictitans, Auburn, Ala., *Geo. F. Atkinson;* Starkville, Miss., *S. M. Tracy.*

Frequently there is very little of the fungus on the leaves, it being chiefly caulicolous. Occasionally it is abundant also on the leaves, but the sori are comparatively small. Sometimes all the sori on the leaves contain only uredospores, but again teleutospores as well.

I have had an opportunity of comparing this species with *R. stictica*, Berk. & Br., n. 554 Myc. Univ., *R. glandulæformis* Berk. & Cur., n. 1251 Myc. Univ., and *R. Texanus* Ell. & Galloway.

I have also collected at Auburn, during the month of September, 1891, *R. glandulæformis* B. & C. on *Tephrosia hispidula* and *Virginiana*, and my assistant, Mr. B. M. Duggar, has collected it on *Tephrosia spicata*. The specimens on Tephrosia Virginiana are of interest from the fact that the fungus is very abundant on the stems, the sori being longer and often confluent, presenting much the same appearance to the unaided eye as Ravenelia Cassiæcola on Cassia nictitans.— GEO. F. ATKINSON, *Department of Biology, Ala. Polyt. Inst., Auburn.*

Cleistogamy in Polygonum acre.—Apropos of Mr. Meehan's discovery of cleistogamy in Polygonum, I would record the observation of cleistogamous flowers on the same species, P. acre, at Knoxville, Tenn., on the 24th of September. For the accompanying illustrations, showing



the appearance of plants in question, I am indebted to Prof. Scribner. I have searched for cleistogamic flowers on other species of Polygonum, but without success.— T. H. KEARNEY, JR., *University of Tennessee.*

Mutilation of the flower of Tecoma radicans.— During the past twenty years I have frequently found flowers of our common Trumpet

Vine split at the lower portion of the tube; the slit usually extending through the upper two-thirds of the calyx, the lower portion of the corolla-tube and down to the nectary. All this time I have been on the lookout for the author of these depredations, and only during the past month have I been successful in detecting him at his work.

For several years my suspicion has been resting on *Icterus baltimore*, for I have on a number of occasions seen him fly from a clump of these flowers in such a manner as to make me believe he had been at work on them; but I did not wish to whisper such a report about a bird of such an unusual beauty, unless I knew it to be true. But several weeks since, while sitting concealed by a window, which is within a few feet of a thrifty Trumpet Vine, then in full bloom, I detected a pair of Baltimore Orioles in the act of slitting the flowers as above described and taking the nectar; since then this observation has been repeated several times.—JACOB SCHNECK, *Mt. Carmel, Ill.*

EDITORIAL.

AT THE Washington meeting of the American Association notice was given of an amendment to divide the Section of Biology. Of course this means to separate the zoologists and botanists; and as the matter will be up for discussion and decision at the next meeting, it is just as well for botanists to begin considering its advisability. The notice of amendment was prompted by two considerations: (1) The extremely crowded program, which compelled the cutting down and mutilation of some of the most important zoological and botanical papers, and also entirely prevented in many cases the presentation of papers by some of our most distinguished biologists. (2) The numerous technical papers in each biological division which were unintelligible to the other. The first consideration may possibly be weakened by the fact that there was, at Washington, a conjunction of an unusually large attendance of biologists and an unusually short allowance of time for reading papers. But three days were allowed, four being the usual number. However, the attendance will be more likely to increase than to diminish, and the working days of the association will probably remain those of the Washington meeting. The second consideration is also an important one, for with the reading of every paper it becomes very apparent that "one-half the world doesn't care how the other half lives." Upon the whole, the GAZETTE is now inclined to favor the amendment, providing such a division will not diminish the in-

terest of the Botanical Club, an exceedingly valuable organization, and one whose informal meetings cannot be duplicated by a Botanical Section of the Association. Even if the division into botanical and zoological sections be made, it will always be desirable to have certain papers of general biological interest read in joint session, a thing commonly provided for in other sections.

CURRENT LITERATURE.

Saccardo's Sylloge Fungorum.

The enumeration and description of all known fungi, a work of enormous magnitude, was begun a decade or more ago by Prof. P. A. Saccardo, of Padua, Italy. The first volume appeared in 1882, and the eighth and last of the regular enumeration two years ago. The eight, thick, royal octavo volumes contained the description of 31,927 species.

It was to be expected that some species would be overlooked, and that new ones would be constantly added, so that the work is no sooner finished than it needs a supplement. The first number of such a supplement is already issued, and botanists will feel under a special debt of gratitude to the author for the promptness with which it has been prepared.

The *Supplementum Universale* is to consist of two volumes, the first of which bears date of September, 1891, and the second is promised for 1892. The present volume [1] is as thick as the thickest of those which have preceded, and contains descriptions of 4463 species, distributed among six large groups, as follows: Hymenomyceteæ 1083, Gasteromyceteæ 72, Hypodermeæ (Ustilagineæ and Uredineæ) 249, Phycomyceteæ 139, Pyrenomyceteæ 2903, and Laboulbeniaceæ 17.

The volumes containing the Pyrenomyceteæ were issued in 1882-3, which partly accounts for the great preponderance of species in that group. The Laboulbeniaceæ appeared in the final volume, 1889, with only 15 species, and the 17 additions of the supplement were all derived from the two publications of Dr. Roland Thaxter, and are all American. Thus the largest and earliest published group shows an increase of 47 per cent., and the smallest and latest published group shows an increase of 113 per cent. Even if we take into view the rusts

---

[1] SACCARDO, P. A.—Sylloge fungorum omnium hucusque cognitorum: Vol. IX, Supplementum universale, Pars I. pp. 1141. Roy. 8vo. Padova. 1891.—fr. 57.

and smuts, which are among the best worked of the fungi, and which show 8 per cent. increase since the volume on that group came out three years ago, the rate at which new species are published is almost appalling, and makes a work like the present well-nigh indispensable.

A book for children.

The books which are adapted to stimulate the interest of children in the plant-world are few enough, when all are enumerated, and those that are even tolerable can be counted on the fingers of one hand. It is with much pleasure therefore that we welcome another,[1] for it belongs distinctly to the better class. Mrs. Bergen has very happily named her little book "Glimpses at the Plant World," and they are surely enticing glimpses which ought to engender a desire for fuller knowledge. In thirteen chapters of five or six pages each the author describes engagingly the different types of plants, yeast, moulds, toadstools, lichens, fresh-water and marine algæ, mosses, ferns and flowering plants. The remaining chapters, about as many more, deal with the fertilization of flowers and the methods of seed distribution, topics which are in their nature attractive and are here made so for children.

Mrs. Bergen's style in this book is easy, in places colloquial, and what is of much greater importance the statements which she makes are not only well put but correct. We recall none that is absolutely incorrect andvery few that one would even wish changed on account of possible misconception. The publishers have given the little book a tasteful dress, but some of the illustrations are open to criticism; such as that of diatoms (?) on page 38, which is only a three inch black circle, with a few scratches in it. The text deserves the best and most artistic work.

A collector's guide.

A new guide for collectors of phanerogams appears from the hand of Professor Penhallow.[2] It contains concise directions for the collection and drying and mounting of phanerogams chiefly, though enough reference is made to the mosses to urge objections against the use of half-size sheets for such smaller plants, objections which appear weighty to the author, we venture to say, only because he never tried

---

[1] Bergen, Fannie D.—Glimpses at the plant-world 16mo. pp. vi. 156. Boston: Lee & Shepard. 1892. [*sic*]

[2] Penhallow, D. P.—The botanical collector's guide: a manual for students and collectors; containing directions for the collection and preservation of plants and the formation of a herbarium. 16mo. pp. 125. figs 8. Montreal: E. M. Renouf. 1891.—75 cents.

the small paper. We note also that standard paper is given as 11×17 inches. which does not quite agree with that most used on this side of the boundary. An appendix shows samples of labels, of mounting and drying paper, genus covers and pockets "for seeds and mosses." (There is a much better form for mosses, by the way.) On the whole the directions are excellent, clear and simple, and in the neat form given them by the publisher, come just at the right time to help along the *renaissance* in collecting to be wrought by the Botanical Club of Canada.

OPEN LETTERS.

Nomenclature from the practical standpoint.

There is one point in this matter of botanical nomenclature on which, with all due respect, very many writers on the subject seem to have gone astray. It has been assumed that there is no reason why botanical nomenclature should not follow the same rules as zoological nomenclature, and hence the priority of names can be as rigidly maintained in the former as in the latter system. This may be very well in theory, but in practice the cases are very different. In zoology generally the scientific names are not in common use outside of scientific circles, while in botany they are. This difference is owing not only to the greater popularity of the latter science, but to the great development of horticulture among the people. In consequence the Latin generic and specific names of plants are used almost as often as some English equivalent, and in many cases to the entire exclusion of so called "common names." This being the case the attempt of certain botanists to change well known names of plants for no other reason save to carry out their own pet theory of nomenclature is almost as hopeless from a practical point of view as an attempt to revise and change the common names of plants in accordance with the individual taste of a certain school of botanists. The nomenclature of a science is not necessarily so much a part of the science that only scientific men can pass on it. Accepted usage has its rights, and generally maintains them whether in accord with theory or not.

A more analogous case, it seems to me, is that of geographical nomenclature. Here also popular usage is a factor, and at once the folly of trying to lay down strict, inviolable rules becomes apparent. Time and time again have the good old historical names been supplanted by names of modern origin, and it would be well nigh useless to make even an attempt to restore them unless the attempt is to be made by authority of the government, not of the individual. Just here appears one of the weakest points of the "strict priority rule" of botanical nomenclature—that it is the creation of the individual, not only unsupported by such governmental botanical authority as we possess, but directly opposed to it in many important particulars. In other words, individual opinion tries to oppose such botanical consensus as we now have in order to carry out its own private theory.

The right of the people to well known botanical names in common use is not likely to obtain much consideration from the herbarium botanist, neither is the application of a statute of limitations to fix definitely the acceptance of such names, yet there is good legal analogy for such a method of treatment, and it would be the business-like and the most familiar way to deal with the subject from a practical standpoint. The advocates of the "strict priority rule" no doubt started with the best intentions and after much careful consideration, but it now seems as if they regarded more the framing and enforcement of an easy rule to follow than a practical rule to secure the most good. Surely their attempts to simplify botanical nomenclature have not given us much relief as yet, and in very many cases show more the ill-directed zeal of the pedant, than the calm, deliberate, common sense judgment of the master. In their attempt to suppress individual dictation in specific cases they claim for themselves the right to dictate the acceptance of a rule that many of us are far from being convinced is the only rule to be followed. We must take the *ipse dixit* dose at the outset instead of later: that is all! Moreover recent events show that this rule, like any rule based on historical facts, does admit of difference of opinion in specific cases, the very evil, I judge, they sought to avoid. Altogether the present condition of botanical nomenclature shows the usual result of allowing theorists to deal with practical matters; for I maintain most stoutly that botanical nomenclature is a living, practical, popular question, and deserves to receive common sense, business-like treatment where there is need of it.

What I have said applies only of course to the so-called "strict priority rule," that extreme, that hard-and-fast rule which enforces priority without exception, reasonable or unreasonable. That priority furnishes a sound foundation for a satisfactory system of nomenclature seems to me beyond dispute, and the work that is being done in many directions is most useful and helpful. When, however, the application of the rule becomes more an object than the avoidance of confusion, when the digging up of long dead, often still-born names becomes of more importance than the retention of names well known and for years accepted by both popular and scientific usage, then many of us feel that temperance is indeed a virtue in questions of botanical nomenclature as well as in other matters of life. Let us at least wait for the action of a Botanical Congress possessing authority, before we accept the tyranny of a rule that knows no exception, listens to no reason, and claims for itself with very little justice, the inviolability of a natural law.— EDWARD L. RAND, *Boston, Mass.*

NOTES AND NEWS.

DR. A. W. SCHIMPER, of Bonn, has declined a call to the University of Marburg on account of his health.

OUR ATTENTION has just been called to a misleading error on page 199 which escaped correction in the proof. In line 16 from the bottom *Pirus* should read Pinus.

MR. FRANCIS DARWIN'S address, as President of the Biological Section of the British Association, was upon "Growth-curvatures in plants."

A NEW "Old-man Cactus," from Lower California, is figured and described by C. R. Orcutt in *Garden and Forest* (Sept. 16). It bears the name of Cereus Sargentianus.

IN EXPERIMENTING upon the climatic conditions for the development of nicotine in tobacco plants, Mr. A. Mayer concludes that increase of heat, light and atmospheric moisture all increase the percentage of this alkaloid.

THE *American Journal of Science* has begun an interesting series of papers, by Dr. George L. Goodale, describing the museums and botanical gardens in the equatorial belt and in the South Seas, which the author recently visited.

IN THE FIRST report of the Sugar-cane experiment station in West Java, W. Krüger has a paper on the diseases and enemies of sugar-cane, which would probably be of value to some of our southern stations. It is published by G. Schönfeld, Dresden.

THE FERNS collected during the past three years in Mexico by Mr. Pringle are being enumerated by Mr. George E. Davenport in *Garden and Forest.* The new species described in the first two parts are Asplenium Pringlei (Sept. 23), A. dubiosum and Hemionitis elegans (Oct. 14). The first and last are figured.

BEYERINCK has proposed[1] a neat test for the excretion of acids by bacteria. He adds to the nutrient medium enough finely divided chalk to make it milky white and opaque. On growing acid-forming microbes in such a medium the colonies of these will render the opaque medium transparent in their vicinity, owing to the solution of the carbonate.

THE *Journal of Mycology* is making itself more and more useful to mycologists, both those of the experiment stations and those who can study mycology for its own sake. Vol. VII, no. 1, issued Sept. 10, marks a new epoch, as it becomes with this new volume the organ of a Division of the Department of Agriculture, and not simply of a section of the Botanical Division.

VINES OBJECTS to Wortmann's view (see this journal xv. 346) that green leaves contain no diastase or only such a small quantity that it is insufficient to account for the transformation of the starch they manufacture into sugar. He has re-investigated the subject and his recent experiments point to the same conclusions as the earlier ones of Baranetzky and Brasse, namely, that there is diastase present in green leaves, and that it does convert the starch into a sugar.

MR. T. S. BRANDEGEE has just published a paper on the "Flora of the Cape Region of Baja California." This very interesting region, known until recently only from the Sulphur and Xantus collections, is being thoroughly investigated by Mr. Brandegee, and also by the Bo-

[1]Centralb. f. Bakt. 9. 781.

tanical Division of the Department of Agriculture. The present paper brings the scattered material together, 179 species being enumerated, 29 of which are new.

A RUST of carnation pinks (*Uromyces caryophyllinus* Schrœt.) has appeared in several places in Indiana, and threatens to be a serious pest to florists. It was brought to the attention of Dr. J. C. Arthur the middle of last month, and investigations show that it is already well distributed in the state, some large greenhouses not having a plant free from it. It has long been known in Germany and southern Europe, but this is believed to be the first time it has been reported in this country.

PROF. LUCIEN M. UNDERWOOD, of DePauw University, Greencastle, Ind., has decided to devote his time exclusively to botany, and offers his entomological library for sale. It contains sets, mostly complete, of American serial publications, the nine Missouri reports by Riley, bound in 2 vols., with index; Fitch's fourteen reports bound in 3 vols., with MS. index; Löw & Osten Sacken's Diptera complete, and many other rare and valuable works. It also includes the nearly complete literature on N. A. Arachnida.

THE ORCUTT Seed and Plant Co., San Diego, Calif., announce the preparation of herbarium specimens of all cultivated plants, which they intend to test at San Diego. The labels will give botanical and vernacular names, descriptions drawn from the fresh plant, color, historical, economic and cultural notes. It is hoped that botanists and horticulturists will lend assistance to the work, as cultivated plants are generally neglected in herbaria.

THE ROYAL Danish Academy of Sciences at Copenhagen offers two prizes of 400 and 600 kronen, respectively, (a) for investigations on the sorts and proportions of the more important carbohydrates present at different stages of ripeness of the four chief cereals; and (b) for investigations of the Phytoptus galls which are found in Denmark with a monographic treatment of the species of the genus of insects producing them. The latter investigation is desired especially to clear up the question as to whether on the same species of plant a given species of Phytoptus may produce different galls at different stages of its development. The prizes are to be awarded in October, 1893.

SOME RECENT researches by Drs. Frank and Otto, of Berlin, have shown that the green leaves of plants are at evening richer in nitrogen than in the morning, and that the leaves themselves show an accumulation of nitrogen, when they are separated from the plant, placed in water and exposed to the direct sunlight. These investigators deduce from their results some conclusions as to the harvesting of plants for fodder (such as clover) which need testing on a practical scale. They recommend the cutting of clover late in the day, preferably toward sunset of a warm, clear day, in order that the greatest amount of the nitrogenous foods, which have the highest nutritive value, may be secured.

IWANOWSKY AND POLOFZOFF describe in the Mémoirs of the St. Petersburg Academy (VII. xxvii. n. 7) a spot disease of tobacco, caused

by a deficient supply of water, which may be occasioned either by a poor development of the root system owing to a lack of potash in the soil, or to lack of moisture in the soil owing to poor cultivation. The spots appear on the lower leaves first, and spread to the upper. They are of very different form and size, frequently enlarge and fuse, and sometimes the tissue involved breaks away entirely. The whole mischief is often wrought in two or three days. Is not the plant subject to the same trouble in this country? Better tillage, selection of ground, with proper exposure and rotation of crops are advised.

THE STUDY of the peach yellows has been a most discouraging task' but Mr. Erwin F. Smith, who has for several years been at work upon the disease for the Department of Agriculture, has shown great perseverance in its investigation. In an address before the Peninsula Horticultural Society at Easton, Md., he asserts that the disease on that peninsula is increasing, and that he has definitely ascertained by inoculation experiments that the disease is contagious. No preventive measures or treatment have been able to check it in the least. In Michgan, however, the eradication of every diseased tree has practically suppressed the trouble, and this is recommended to the Delaware and Maryland growers. While several organisms have been found associated with the diseased tissues, none has yet been proved to be the cause of the malady.

THE LAST PART of *Pittonia* (Vol. II., part 10), just issued, is an interesting one, as all the parts are. Of course numerous new species are described. Achætogeron is included under Erigeron and its species properly renamed. The most interesting part is always that which deals with ancient names of genera, as one never knows what unheard of name is to be suggested for his old friends. In the present paper 9 genera are thus treated and their 79 species renamed. *Polanisia* is changed to *Jacksonia* Raf., *Wistaria* to *Kraunhia* Raf., *Riddellia to Psilostrophe* DC., *Troximon* to *Agoseris* Raf., *Pyrrhopappus* to *Sitilias* Raf., *Cordylanthus* to *Adenostegia* Benth., *Echinospermum* to *Lappula* Mœnch., *Microstylis* to *Achroanthes* Raf., and *Symplocarpus* to *Spathyema* Raf. A new and promising field of nomenclature is opened up in the case of revertible names. No genus is now to be allowed to bear a revertible name (that is one that appears as the more ancient synonym of any other genus). Accordingly, simply by way of mentioning "but a few out of many changes" which are promised, the author proceeds to coin generic names. *Pickeringia* Nutt. is renamed *Xylothermia; Nuttallia* T. & G. is *Osmaronia; Darlingtonia* Torr. is *Chrysamphora; Crantzia* Nutt. is *Lilæopsis; Rafinesquia* Nutt. is *Nemoseris; Torreya* (used with 5 genera) is *Tumion* (this time of Raf.). In the same part, Professor Greene replies to the criticisms that have been made of his citation of ancient botanical authors, and also inveighs against the Negundo Negundo and Catalpa Catalpa departure in nomenclature.

On the relationships of the Archegoniata.[1]

DOUGLAS HOUGHTON CAMPBELL.

Under the name of Archegoniata are usually included the bryophytes and pteridophytes, but we may also include with them the gymnosperms, as all three groups agree in the presence of an unmistakable archegonium, which while differing in some details has such similarity of structure as to point to an almost certain, although remote, common origin for all three groups.

This homology was first shown by Hofmeister[2] in his remarkable series of investigations upon the higher cryptogams and gymnosperms, and has since been the subject of numerous investigations, so that a great mass of material has accumulated.

Numerous attempts have, of course, been made to trace out the inter-relationships of these groups; but recently a good many new facts have been discovered which may throw a somewhat different light upon these, and it is the intention here to call attention to these, and attempt to point out what their bearing is upon the point in question. In trying to do this, the data assumed are mainly derived from the results of a developmental study of the different forms, coupled with such evidence as the palæontological record has to show. Unfortunately the latter is too fragmentary, as regards the lower forms and the more delicate parts of the higher ones, to be of very much service in the study of these points; still very valuable material has been brought to light, and probably much more will be discovered if a systematic search is made.

It is generally admitted that we are to look for the ancestors of the higher plants among the fresh water green Algæ. On account of the structure of the sexual organs, as well as the occurrence of a sort of protonema, the Characeæ have sometimes been regarded as the nearest approach among existing Algæ to the mosses; but if this is so, the ancestral forms must have been of a much less specialized character than even

[1] Read before Section F, A. A. A. S., Washington Meeting, August, 1891.
[2] The higher Cryptogamia

the simplest of living forms, and it seems more probable that of living Algæ, the higher Confervaceæ such as *Coleochæte*, come nearer to this hypothetical form.

The first of the groups with which we have to deal, the Bryophyta, or Muscineæ, is readily divisible into two classes, the liverworts (Hepaticæ), and true mosses (Musci). There has been some controversy as to which of these is nearest the primitive stock, and to the higher plants. A comparison of the two groups will show, however, very strong reasons for considering the Hepaticæ as the more primitive group. Although far outnumbered in species by the true mosses, the Hepaticæ show a much greater diversity of form, both of the gametophyte and sporophyte than is the case with the Musci, which form a remarkably close group with relatively insignificant differences (excepting in the case of *Sphagnum*); and the higher ones, with their very peculiar and highly specialized sporogonium, are evidently very remote from any other group of plants. The Hepaticæ, on the other hand, offer a very strong contrast to this. Several divergent stocks are evident, all traceable to a common form and touching in certain respects, Algæ, Musci, and Pteridophyta. The thallus of such simply organized forms as *Anthoceros* or *Pellia*, is but a slight advance on the higher green Algæ, although it must be borne in mind that this simplicity does not extend to the sexual organs and sporophyte. On the other hand, these same forms are connected directly with the Musci through *Sphagnum*, and as the writer has endeavored to show before,'[1] to such pteridophytes as *Ophioglossum*.

If we now study a little more closely the relation of the Hepaticæ, *inter se*, we can distinguish three well-marked series of forms diverging from a common stock. Nearly all liverworts pass through a more or less well-marked thallose stage which is persistent in some of the simpler thallose Jungermanniaceæ such as *Aneura* and *Metzgeria*. This is a simple flat often heart-shaped thallus, growing from a single apical cell. It is usually, although not always, traversed by a well-marked mid-rib. The frequent recurrence of this stage in the development of so many forms of Hepaticæ, as well as in the prothallium of the isosporous ferns, is most readily explained by the assumption that this represents the ancestral type from which both groups have sprung. Granting this to

[1] The affinities of the Filicineæ: Bot. Gaz. Jan., 1890.

be the case, the thallose Jungermanniaceæ are to be regarded as the most primitive of living forms, and not the Ricciaceæ, which are usually so considered. It seems more likely that the latter, together with the very closely related Marchantiaceæ, represent a group in which the thallus has become highly differentiated, without a corresponding development of the sporophyte, and which reaches its highest expression in such forms as *Marchantia* and *Asterella*. Of course it is possible to regard the simpler Ricciaceæ as the primitive forms from which the Jungermanniaceæ have sprung; but this would involve a reduction of the thallus in the latter which seems hardly probable, as in some Marchantiaceæ, and probably in the Ricciaceæ also, the young thallus corresponds closely to to that of the simpler Jungermanniaceæ, and the massive thallus of the older plant arises secondarily. The very simple sporogonium of *Riccia*, of course, is an important point in determining its systematic position, and indicates, that if, as here suggested, the Ricciaceæ are derived from forms like the lower Jungermanniaceæ, it must have been at a very early period, before the sporogonium of the latter had reached its present stage of development.

Leitgeb[1] has already called attention to the connection of *Anthoceros* with the Jungermanniaceæ, and the evolution of the foliose forms of the latter group from the thallose forms is easily demonstrated.

We may then pretty safely assume that the primitive liverworts were thallose forms not unlike such existing forms as *Metzgeria*, or the prothallium of an *Osmunda*, and that from these, three stocks diverged, the Ricciaceæ (including Marchantiaceæ), the Anthoceroteæ, and the foliose Jungermanniaceæ. The first and third of these groups forming the great bulk of the living forms are to be regarded as specialized branches that end blindly; the second, however, is especially important from a morphological standpoint, as it probably represents to a considerable degree, the ancestral form from which both the true mosses and the Pteridophytes have sprung.

The Anthoceroteæ[2] differ remarkably from the other liverworts, especially in the development of the highly specialized sporogonium. This finds its nearest homologue, not among the Hepaticæ, but in the lowest order of the true mosses, viz.:

---

[1] Untersuchungen über die Lebermoose, Vol. V, pp. 8–9

[2] Leitgeb, l. c.

the Sphagnaceæ. The close similarity in the development of the sporogonium in these two groups, can only be explained on the assumption of a common origin, and this is strengthened by the fact that the protonema of *Sphagnum* is a large, flat thallus instead of the filamentous form common to most mosses. In short, *Sphagnum* forms a link between *Anthoceros* and the true mosses.

This is true of the protonema, as well as the sporogonium, for while the younger protonema is at first a simple flat thallus, later there may grow out from its margin filaments which have all the characters of the ordinary protonemal branches of the higher mosses, including their peculiar oblique septa. These filamentous branches, as well as the leafy stem, are secondary, and it is difficult to see how we can assume that the former represents the primitive condition, as Goebel[1] and Bower[2] assert. It seems much more in accordance with the facts to believe that the flat thallus represents the primitive form of all, and that in the mosses, as the leafy branches bearing the sexual organs became more and more prominent, the large prothallium-like protonema gradually became lost, being replaced by the secondary filamentous form found in most mosses.

The foregoing attempt to point out the connection of the different groups of the bryophytes may be illustrated by the diagram on the opposite page.

The probable connection of the Anthoceroteæ with the Filicineæ has been noted by several investigators,[3] but the assumption has been usually made that the relationship must be sought with the Leptosporangiatæ, as these have been regarded as the lowest of the forms. Of the leptosporangiates the Hymenophyllaceæ have usually been regarded as the most primitive, this opinion being based mainly upon the delicate character of the sporophyte. The most recent investigations, however, do not bear this out, and the attempt of Prantl[4] to homologize the sporogonium of *Anthoceros* with the sporophyte of *Hymenophyllum* involves such an amount of pure speculation and so little real morphological correspondence as to be very far from convincing.

---

[1] Morphologische u. biologische Studien: Ann. du Jardin botanique de Buitenzorg, Vol. VII, p. 115.
[2] Annals of Botany, Vol. III, No 11, p. 372.
[3] Leitgeb, l. c., Vol. VI, p. 60.—Prantl, Hymenophyllaceæ, p. 62.
[4] L. c., p. 62.

From a very careful study of the question, the writer[1] was led to a very different view as to the relative position of the different groups of the Filicineæ, and gave what seemed to him strong evidence in favor of considering the eusporangi-

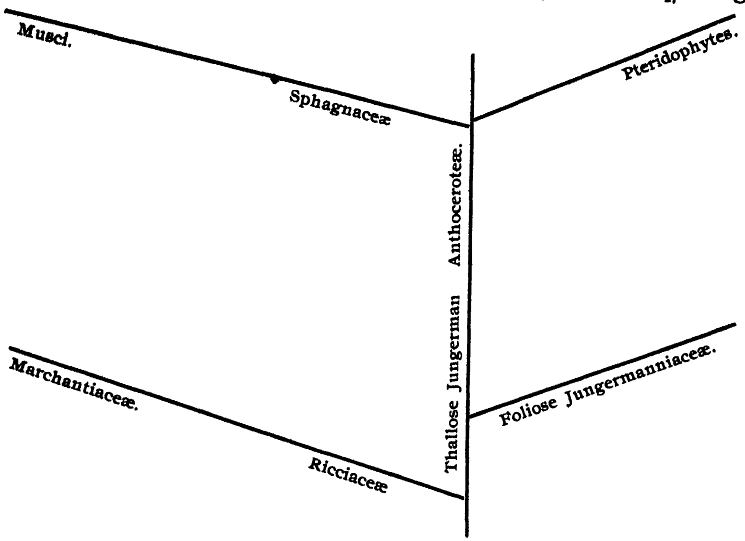


DIAGRAM I, illustrating the inter-relationships of the bryophytes.

ate forms, which hitherto were regarded as the highest of the ferns, as the primitive forms from which the Leptosporangiatæ have been derived. Ophioglossum was considered to be the nearest of the existing forms to this ancestral form, so far as can be judged from a study of the structure of the sporophyte.

Of the three classes of the pteridophytes, the ferns form a very large majority and constitute the prevailing type of the existing forms. If we compare the number of species in the three classes, we shall find that the Filicineæ comprise at least 90 per cent. of living forms, and that of the 3000 or more species of ferns an overwhelming majority belong to one family—the Polypodiaceæ. This fact, in connection with the highly differentiated sporangium, and other structural peculiarities, led me to express the opinion that the Leptosporangiatæ (of which the Polypodiaceæ are the type), instead of representing the primitive group of ferns, were in fact a com-

[1] Affinities of the Filicineæ, p 3.

paratively modern, specialized group, comparable to the leafy liverworts or the true mosses. There is no geological evidence to show that the true leptosporangiate ferns were ever much more numerous or better developed than at the present time. On the other hand, the geological record, as well as embryological study, so far as the latter has been applied to them, points to the primitive nature of the Eusporangiatæ.

The most recent and careful study of the carboniferous and pre-carboniferous ferns, show that their affinities were not with the Leptosporangiatæ, but with the Eusporangiatæ, especially the Marattiaceæ. Forms probably referable to the Ophioglosseæ, and probably also to the Osmundaceæ,[1] have also been found, but no unmistakable leptosporangiate remains are known until the early Mesozoic formations, from which time they increase rapidly in number and variety. Solms-Laubach[3] justly remarks that if such forms did exist in the earlier formations, it is exceedingly strange that, among the innumerable perfectly preserved leaves, a structure so durable as the annulus of the sporangium should have failed to be preserved in a recognizable condition.

The ontogeny of the Eusporangiates, so far as known, harmonizes with the geological evidence. The prothallium is more massive, and longer-lived than in the leptosporangiates, in this respect approaching the liverworts, and the sexual organs show points of primitive structure. Unfortunately the embryogeny is scarcely at all known in any of the homosporous forms, which are presumably the most primitive and approach most nearly the ancestral type.

From a series of investigations recently completed by the writer, it appears that the Osmundaceæ are about midway between the true Eusporangiatæ and the Leptosporangiatæ, both in regard to the prothallium and the embryo. The intermediate character of the tissues of the sporophyte has already been repeatedly called attention to by various writers. The prothallium resembles to a remarkable degree that of certain liverworts, notably *Dendroceros*, and the sexual organs approach in certain respects the Marattiaceæ, but also recall *Equisetum* and even certain bryophytes. The embryo is noticeable on account of the large size of the foot and its long depend-

---

[1] Solms-Laubach: Palæophytologie, p. 156.
[2] Bower: Annals of Botany, May, 1891.
[3] L. c., p. 156.

ence upon the prothallium, as well as the great development of the calyptra, all of which are evidences of the primitive character of the group, and in all of which, so far as known, it approaches the Eusporangiatæ. An interesting point noted was the fact that the primary root grows from a single tetrahedral apical cell, as in all of the Filicineæ except the Marattiaceæ and *Isoetes*, while the later roots, at least of the two species studied, *O. Claytoniana* and *O. cinnamomea*, possess a four-sided pyramidal apical cell. This seems to indicate that the former is the primitive form which has been retained in all except the Marattiaceæ and the probably allied *Isoetes*. Whether this state of things obtains in the embryo of the former of these is not known, but it is not impossible; in the latter a trace of this is sometimes seen in the very earliest stages of the embryo, but is lost before the root is fully grown.[1]

In the course of these investigations points of resemblance, both in the prothallium and sexual organs were noted, that recalled the corresponding points in *Equisetum*. So numerous were these, that it led to a belief of a nearer relationship between the Equisetineæ and Filicineæ than is usually maintained, and to warrant the possible union of the two classes into a group opposed to the Lycopodineæ. Van Tieghem[2] has called attention to correspondences in the sporophytes of *Equisetum* and *Ophioglossum* which confirm this view. It is even possible that this might be carried so far as to assume a common origin for these two classes, distinct from that of the Lycopodineæ which in some respects recall rather the true mosses than the liverworts. One great difficulty in dealing with the Lycopodineæ, and especially the Equisetineæ, is that they are degenerate forms which have lingered after their larger and better organized kindred have disappeared, and it is difficult to judge which are primitive and which secondary characters. Certain it is, that the investigated species of *Lycopodium*[3] differ more from *Equisetum*, than does the latter from the homosporous Filicineæ. Still we are not yet in a position to speak positively on this point.

Of the true leptosporangiate ferns, the reasons already given

---

[1] Campbell: Annals of Botany, Vol V, No 19, p. 243.

[2] Unfortunately the paper was not accessible.

[3] Treub: Études sur les Lycopodiacées, Ann. du Jardin botanique de Buitenzorg, Vols. 4, 5, 7.

seem to warrant the assumption that in the Polypodiaceæ we have to do with a group of comparatively modern forms that have arisen from the more ancient Eusporangiatæ through the Osmundaceæ, Gleicheniaceæ and Cyatheaceæ, which families constitute a quite natural series. The two families, Hymenophyllaceæ and Schizæaceæ, while evidently connected with the lower members of this series, seem to form two offshoots from the main line of ascent, and the former is probably a degenerate group whose peculiarities are largely due to the effects of environment. The affinities of the Hymenophyllaceæ seem to be with the Gleicheniaceæ and Osmundaceæ. The form of the sporangium and spores, as well as the prothallium and sexual organs, is of the type found in these groups. The branching filamentous prothallium, upon the importance of which too much stress has been laid, is by no means rare in *Osmunda Claytoniana* under certain circumstances, and the form of the sexual organs is very similar.

As to the sporophyte, the Ophioglosseæ form a natural series with *Ophioglossum* at the bottom, and such species of *Botrychium* as *B. Virginianum* at the top, the latter connecting the group with the Osmundaceæ.

The Marattiaceæ, as might be expected of such ancient forms, show affinities with both the Osmundaceæ and Ophioglosseæ, and may perhaps be regarded as a branch of the original stock that, beginning very far down, reached its maximum development in the Carboniferous era, and then declined. Whether, as suggested by Bower,[1] the spermaphytes have arisen from the same stock, must at present remain conjectural.

The forms hitherto discussed are the so-called isosporous forms. Among the existing pteridophytes, however, are four very distinct groups in which spores of two kinds are found, viz.: Selaginelleæ, Isoeteæ, Marsiliaceæ, and Salviniaceæ. The first of these is evidently enough related to *Lycopodium*, and the third to the Polypodiaceæ; but the affinities of the others are not so clear. The Salviniaceæ, while clearly enough belonging to the Leptosporangiatæ, and related to the lower members of the series, still are so peculiar that it is not easy to decide where they should be placed. Prantl[2] suggests the Hymenophyllaceæ as their nearest allies, and prob-

[1] Annals of Botany, Vol. III, p. 387.
[2] The Schizæaceæ, p. 153

ably either these or the Schizæaceæ are to be so considered. *Isoetes* is even more difficult to place. It is unquestionably the nearest among living pteridophytes to the spermaphytes, but with what group of homosporous ferns it is most nearly related, is hard to say; for while showing evident relationship to several forms, they are in widely separated groups. On the whole, the evidence is in favor of regarding it as nearest the Marattiaceæ; but this is liable to be changed when the embryogeny of the latter is known, and the life history of the Ophioglosseæ. (See diagram 2.)

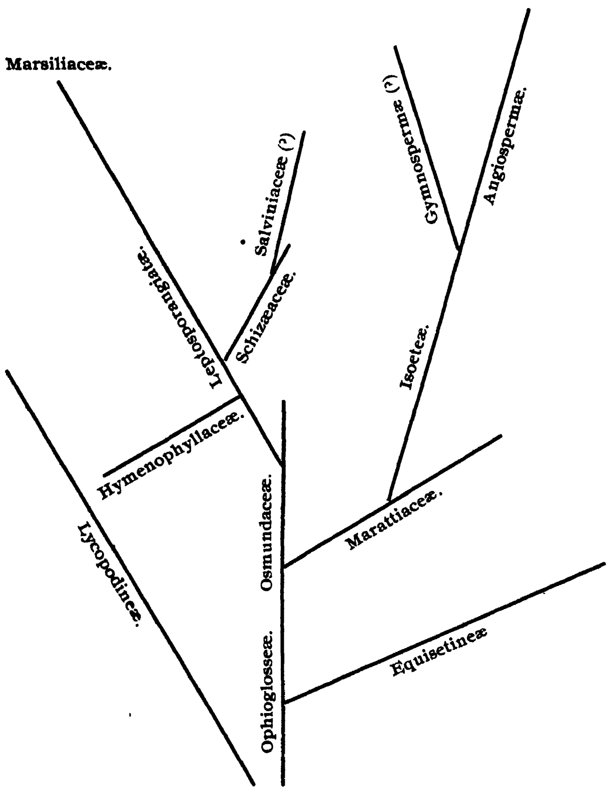


DIAGRAM 2, illustrating the ontogeny of the vascular cryptogams and spermaphytes.

The tendency toward the separation of the sexual organs, occasionally found in nearly all forms examined, occurs regu-

larly in *Equisetum* and many Polypodiaceæ. This tendency has been attended by a greater and greater reduction of the prothallium, which finally, in such forms as *Isoetes*, has lost all power of independent existence, and serves simply to nourish the sporophyte until it can live alone. In these two, the sex of the prothallium is already indicated by the two sorts of spores. This carried a step further resulted in the macrospore being retained permanently within the sporangium which did not separate from the sporophyte until the prothallium was developed.

At first, as is still the case in *Ginkgo*[1] and some cycads, fertilization was not effected until after the sporangium (seed) became detached; but in the higher forms, fertilization and the formation of the embryo were completed before the seed ripened, as is seen in the Abietineæ, for example.

Inasmuch as heterospory was developed independently in several widely separated groups, the question naturally arises whether the formation of seeds may not also have taken place in more than one line, and that all of the spermaphytes have not necessarily arisen from the same stock.

The great gap between gymnosperms and angiosperms it is at present impossible to bridge over, and the possibility of a separate origin of the latter directly from some group of pteridophytes is by no means improbable. The writer's recent investigations upon the embryo of *Isoetes*[2] have shown that it much more nearly resembles that of a typical monocotyledon than it does the gymnosperms, and as the prothallium is hardly more differentiated than in the latter, it is about as easy to imagine the monocotyledons to be derived directly from forms like *Isoetes* as from the gymnosperms.

As might be expected, there is much difference of opinion concerning the inter-relationships of the spermaphytes. The view ordinarily accepted is that of Strasburger,[3] who derived the gymnosperms from forms intermediate between ferns and lycopods, but having their nearest affinity among living forms with *Selaginella*. This common stock then divided into two branches, cycads and conifers, and from the latter through the Gnetaceæ, were derived the dicotyledons, from which as a degenerate group the monocotyledons have descended.

---

[1] Goebel: Outlines, p. 338.
[2] The life history of Isoetes echinospora, Ann. of Bot. Vol. V. No. 19.
[3] Coniferen und Gnetaceen, p. 258.

Kny[1] claims a distinct origin for the two divisions of the angiosperms. He says, "The two principal divisions of the angiosperms, dicotyledons and monocotyledons, represent two great independent lines of development, whose origin reaches at least as far back as the vascular cryptogams, if not lower." He is inclined with Strasburger to connect conifers and dicotyledons with the Lycopodineæ, and would derive the monocotyledons directly from the ferns.

Prantl's[2] views are much the same as Kny's, except that possibly a part of the dicotyledons have a common origin with the monocotyledons.

From the evidence at present available, both of embryology and palæontology, the assumption of a separate origin for the two groups of the angiosperms is certainly unwarrantable. In all forms yet investigated, the uniformity in the essential structure of the flowers, and especially the development of the embryo-sac, points unmistakably to a common origin. It may be that further investigations upon the lower members of both groups may modify this view, but that such extraordinary correspondence as exists in the formation of the embryo-sac, the structure of the egg apparatus, the fusion of the endosperm nuclei, etc., could have arisen independently in the two groups is inconceivable.

On the other hand, the evidence for a direct connection of gymnosperms and angiosperms, is not entirely convincing, and the possibility of a separate origin for these two groups is by no means unlikely—nay, seems quite probable.

Whether the origin of the angiosperms is to be looked for directly from the Filicineæ, through such forms as *Isoetes*, or from forms higher up like the cycads, can only be satisfactorily answered after many forms have been thoroughly studied. As yet our knowledge of the embryology of the cycads and the simplest angiosperms is too incomplete to make an answer to this question more than a mere conjecture.

Palo Alto, California.

---

[1] Entwickelung der Parkeriaceen, p. 61.

[2] Hymenophyllaceæ, p. 68.

A new herbarium pest.

C. V. RILEY.

In the year 1890 a number of small Geometrid larvæ, recalling somewhat in appearance those of the genus Aplodes, were found by the botanists of the Department of Agriculture infesting certain dried plants in the Department herbarium, and especially those which had been received from Mexico and Lower California, from Dr. Edward Palmer. Dr. J. N. Rose first observed it in January, 1890, on plants from La Paz, but it was still more abundant in a collection from the State of Colonna, Mexico, made in the beginning of the present year. Being referred to me for identification, I became much interested in the matter, as it was the first case that had come under my notice of a Geometrid larva feeding upon dried plants. The matter acquired additional interest also because the species was evidently new and there was danger of its being spread through distribution into other parts of the world. I therefore took steps to watch the course of the insect and rear it to the imago state. This was done some time ago and I have had drawings of the different stages finished for some time, and call attention to the matter now because the trouble has grown in the Department herbarium and it is of sufficient importance to put on record. The first moth emerged October 22d, 1890, and others were subsequently reared from material received from time to time from the Department herbarium. While the larva was first discovered, as stated, on Mexican plants, it has not confined its work to such plants, but has spread to others and is by far the most destructive herbarium pest which the botanists in charge have to deal with. Plants of the genus Coulterella, for example, which were sent by Dr. Rose to Dr. C. Hoffman in Berlin, have been so injured that but one perfect flower remained; yet, according to the observations of Mr. L. H. Dewey, in overhauling the herbarium, the insect's work is still mostly confined to southwestern plants; after these from Mexico, chiefly those from California. In some cases eastern plants have not been attacked, even when associated with western, but in one case at least, viz.: Rhus toxicodendron, eastern plants have been extensively infected.

The larvæ feed on the flowers and also to some extent on the leaves. More rarely they feed on the hard fruits and seeds. The following list, kindly prepared by Mr. Dewey,

of the plants upon which the larvæ had been found prior to its work on Rhus toxicodendron will be of interest in this connection.

Species	*Order*	*Locality*
Ptelea aptera.	Rutaceæ	S. California
Ceanothus sorediatus	Rhamnaceæ	S California.
Dalea Seemanii	Leguminosæ	S. California
Lupinus coccineus	Leguminosæ	Arizona
Purshia tridentata	Rosaceæ	Arizona
Prunus demissa	Rosaceæ	S. California
Ribes viburnifolia	Saxifragaceæ	S California
Epilobium angustifolium[1]	Onagraceæ	E Massachusetts
Arctostaphyllos oppositifolium	Ericaceæ	S California
Eriodictyon glutinosa	Hydrophyllaceæ	Arizona
Gilia Rusbyi	Polemoniaceæ	Arizona
Pentstemon secundiflorus	Scrophulariaceæ	Arizona
Audibertia Clevelandii	Labiatæ	S California
Dracocephalum parviflorum	Labiatæ	Arizona.
Salvia ballotæflora	Labiatæ	Arizona

The eggs are laid upon the plants or on any surrounding object. They are but slightly attached, bluntly ovoid, 0.3 mm. wide and 0.4 mm. long. They are steel-gray in color, the shell white with faint iridescence when empty, and faintly and irregularly reticulate. The duration of the larval period

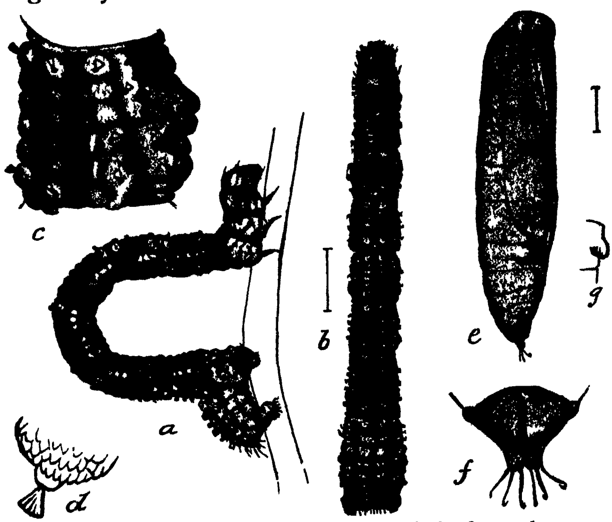


FIG. 1. *Carphoxera ptelearia: a*, larva from side; *b*, do. from above; *c*, side view of abdominal joint of same; *d*, tubercle of same; *e*, pupa; *f*, do. cremaster; *g*, do. abdominal projection.—*a*, *b*, *d*, enlarged about six times; *c*, *d*, *f*, still more enlarged. (Original.)

[1] E. angustifolium grows in the West but mostly in northern California and Oregon.

has not been determined. Growth, however, is very slow, and the period from the egg to the full larval growth is variable. The larval life extends in some cases certainly over a period of three months. When full grown the larvæ attain a length, extended, of 8 mm.; contracted when disturbed or at rest of 5 to 6 mm. Whenever disturbed they contract considerably and become rigid and motionless. The larva is shown in characteristic positions in the accompanying illustration (fig. 1, *a*, *b*). It is dull grayish in color, varying considerably in different specimens. On reaching full growth the larva constructs a cocoon of loose white silk, forming an irregular open network as shown in fig. 2, *b*. The cocoon is usually placed in a fold of the leaf or is otherwise protected by the plant, and is occasionally partly covered with bits of anthers or fragments of leaves. In shape it is irregularly ovoid and is about 6 mm. by 3.5 mm. The change to pupa takes place about three days after the cocoon is completed and the moth usually appears eighteen to twenty days after pupation. The pupa is 5 mm. in length, somewhat robust, and is slightly yellowish in color, with sutures and tip brownish, the latter being quite dark. A peculiar pad or flap-like projection occurs on the side of the fifth abdominal joint (fig. 1, *e*, *g*). The cremaster is produced, notched at the tip and armed with six long hooked hairs or spines (fig. 1, *f*). The adult insect is about 5 mm. long and expands from 13 to 14 mm. The general color is greyish-yellow inclining to saffron, the primaries being somewhat darker. The wings are marked (fig. 2, *c*) with transverse bands of dusky shade, and each wing has a discal spot. The head is dark brown, with the antennæ, including a large spot on the vertex, yellowish. The under surface is nearly concolorous, the dark bands being

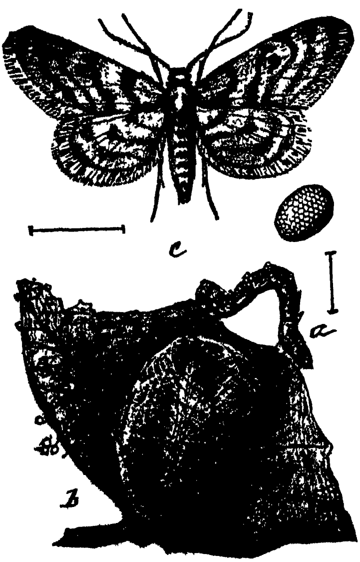


FIG. 2 *Carphoxera ptelearia* · *a*, larva; *b*, cocoon; *c*, moth; *d*, egg—all enlarged. (Original)

less distinct, and the discal spot more intensified. The fringes are concolorous with the ground color and with black dots beyond the veins.

This insect has become a source of positive alarm in the Department herbarium on account of its rapid multiplication and the harm it occasions. It behooves botanists to be on the lookout for it and to adopt such measures as will insure immunity from it, if dry specimens are being received from Mexico and the southwest, or from herbaria in which it is known to occur. The custom of poisoning dried plants with corrosive sublimate to protect them from various enemies, such as book mites, Psoci, etc., should give immunity from the attacks of this insect if the poison has been thoroughly applied. If to the corrosive sublimate a quantity of arsenic is added, the protection will be more effectual. I would also recommend as very useful in disinfecting herbaria of this and other pests an air-tight quarantine box of zinc or galvanized iron in which the plants may be temporarily placed and submitted to the fumes of bisulphide of carbon, which are very sure to destroy all insect life. Effective steps have already been taken to prevent the sending out from the Department of any infested specimens in future.

The fact that this insect has appeared in dry plants from the comparatively arid western regions may furnish a clew to its original habit. It is presumable that it normally feeds on the dead or dried plants of Mexico and adjacent arid regions, and that it has simply adapted itself to the somewhat similar conditions prevailing in herbaria.

This is the first true Geometrid, so far as I know, recorded as feeding on dry and dead vegetation. In the Pyralidina a number of species are known to be not only truly carnivorous, feeding on other insects, but also to feed upon grass and rejectamenta as well as dead leaves. Some Tineina are also known to have similar habits, while in the Deltoid group of Noctuids several genera are known to feed on dead leaves.

The illustrations, which have been prepared for *Insect Life*, are used by permission of the Hon. Edwin Willits, Assistant Secretary of Agriculture, who desires to give the facts in the case as wide circulation as possible, and who is particularly anxious that the Department shall not be the means of distributing any undesirable introductions.

U. S. Dept. of Agric., Div. of Entomology.

Notes upon Peronosporeæ for 1891.

BYRON D. HALSTED.

The season now closing has been an average one as to the total amount of rainfall, but the two previous years were moderately wet ones, and particularly 1889. Of special note in this connection is the amount of rain that fell during the month of August, namely, 5.32 inches on an average throughout the state; while the September precipitation was not so great but near the average.

PHYTOPHTHORA INFESTANS D. By. While not one quarter as prevalent as last year this rot has not been absent, especially among the late potatoes. It was first observed in July, about ten days after a series of rains. The writer is more than ever convinced that much of the decay of Irish potatoes in the East is due to bacteria and the Phytophthora gets credit for much more damage than is its due.

SCLEROSPORA GRAMINICOLA (Sacc.) Schr. which is common upon *Setaria viridis* and *S. Italica* in Iowa, has not yet been found in New Jersey. The first host for this mildew gives one of the best illustrations of how the sustaining tissue breaks up into fine shreds as if to facilitate the dispersion of the oospores as it doubtless does.

PLASMOPARA VITICOLA (B. & C.) Ber. & De T. was comparatively rare upon the grape during the early part of the year, but after the crop was removed the mildew showed itself upon the mature leaves in remarkable abundance. So rapid and great was its growth in September that the vineyardists frequently mentioned the fact of their own accord. This seems to be a striking example of the mildew being associated with the moist weather of the autumn. It has been again observed that the lower leaves, that is, those nearest the soil, are the most certain to be attacked, leaves lying upon the earth being worst of all. It has not been as abundant upon *Ampelopsis quinquefolia* and *A. tricuspidata* as last year.

PLASMOPARA PYGMÆA (Ung.) Schrœt. was found in small quantity in early spring upon *Anemone nemorosa* but not met with upon its other hosts.

PLASMOPARA GERANII (Peck) Berl. was in early spring one of our most abundant and conspicuous members of the group, as upon *Geranium Carolinianum* it covered the leaves with a

white felt and developed a premature reddening of the affected foliage. In midsummer it disappeared only to appear again upon the seedling plants in autumn ready for its hibernation in the substance of its hosts. It was taken also upon *G. maculatum* but not upon *G. Robertianum.*

BREMIA LACTUCÆ Reg. has only been met with upon garden lettuce and principally in green-houses where it did some damage.

PERONOSPORA PARASITICA D. By. is one of the most wide-spread and common of all the mildews. It has been observed on nearly all the ordinary hosts, as *Cardamine hirsuta* and *C. laciniata* in early spring, and radish and cabbage later in the season. A new host apparently in *Alyssum maritimum* was found affected, growing in a green-house with radishes near by, likewise infested. The Cruciferæ in general are subject to the attacks of this mildew.

PERONOSPORA CUBENSIS B. & C. has been the most interesting species this season. It will be recalled that this mildew, in the spring of 1889, was known only in Japan, Cuba and this state. During that year it was found in the southern states. Last year it was only rarely met with, but almost daily looked for. Until midsummer of the present season it had not been found, but since then it has appeared, literally almost everywhere in this region, and through correspondence it is learned that it is very wide spread and general. From Professor Galloway I learn that it is abundant in Washington, and Dr. Sturgis sent specimens from New Haven, where it was common upon watermelon. Upon the same host it seems accountable for the failure of the crop to some extent in this vicinity. No oospores have been met with, but the rapid germination of the violet conidia by zoospores is easily demonstrated. The wild species of Cucurbitaceæ, namely, *Sicyos angulata* and *Echinocystis lobata*, have been examined with the hope of finding the mildew, but without success.

PERONOSPORA EFFUSA Rabh. has been much more abundant this season than formerly. The crop of spinach now standing in some places is badly spotted with the mildew, which will materially shorten the crop.

PERONOSPORA POTENTILLÆ D. By. has been taken occasionally upon the common host *Potentilla Norvegica*, but of most interest is the finding of it upon *P. grandiflora* which,

while recorded in Saccardo, is perhaps new to this country. The oospores were in abundance. It was also luxuriant upon *Potentilla Nepalensis*, in which also oospores were present.

CYSTOPUS IPOMŒÆ-PANDURATÆ Farl. has been abundant upon the sweet potato foliage and the oospores in the galls of the *Ipomœa pandurata* as mentioned last season. In no case were the galls found upon the former host.

CYSTOPUS CANDIDUS (Pers.) Lév. has its long list of hosts, and in this is a match for *Peronospora parasitica*, both frequently growing together upon the same species of Cruciferæ. Fine specimens with chalky white patches of large size were found unusually abundant upon some horseradish plants, and in this vicinity during June the shepherd's purse is fortunately quite seriously affected by this white mold.

CYSTOPUS PORTULACÆ (DC.) Lév. in like manner assists materially in killing off the purslane.

As a whole this has been a year in which the mid-season was characterized by few Peronosporeæ, but the quota has been well filled by the rapid development of several species in great abundance late in the season. The frosts of autumn held off unusually late, and this, together with the heavy rains, gave these parasites a good opportunity to make a rank growth. The other points of particular interest have been the finding of *Peronospora parasitica* upon *Alyssum maritimum; P. Cubensis* in great abundance upon cucumber, pumpkin and squash, and quite destructive to watermelons; *P. effusa* abundant upon spinach; and *P. Potentillæ* upon *Potentilla grandiflora* and *Potentilla Nepalensis*, both hosts abounding in oospores.

Rutgers College, New Brunswick, N. J.

New plants collected by W. G. Wright in western Mexico.

B. L. ROBINSON.

Ayenia Wrightii.—Fruticose: branches terete, smooth: leaves ovate, acuminate, rounded at the base, serrate, glabrous on both sides, a little paler beneath, $1\frac{1}{2}$–2 inches long, half as wide; some much smaller leaves, 4–6 lines in length, fascicled together with the flowers in the axils of the larger

ones ; petioles 3–9 lines long : flowers two to five in a group, without a common peduncle; pedicels 3 lines in length; sepals lanceolate, acuminate, about a line long; petals with blades broadly rhombic, entire at the attachment of the hair-like claw, but with four teeth near the apex, the two inner teeth very minute, close to the adnation to the staminal cup, the outer much larger, acuminate, abruptly bent downward and backward ; anthers two-celled ; ovary raised on a slender stipe of 1 line in length; fruit $1\frac{1}{2}$–2 lines in diameter, covered with numerous small dark glands.—Head of Mazatlan River, January, 1889 (No. 1307). Differs from *A. truncata* Rose in its terete branchlets, the longer and more slender stipe of the ovary and in the character of its fruit.

Mimosa affinis.—Annual, sensitive: stem ascending, simple or branched, hirsute with spreading or reflexed yellowish-brown hairs and armed with small recurved sub-stipular and scattered spines: petioles an inch long, bearing a single pair of pinnæ: leaflets 9–12 pairs, oblong, acutish, 5–7 lines long, the lowest pair appressed-pubescent upon the lower surface, the others nearly glabrous except on the ciliate margins; stipules awl-shaped, striate, ciliate; stipels bristle-formed, more or less rigid and dark-colored : peduncles shorter than the petioles, bearing small nearly spherical heads 2–$2\frac{1}{2}$ lines in diameter; bractlets awl-shaped to bristle-formed, ciliate, exceeding the flowers; corolla 4-parted; stamens 4; legumes 1–4 seeded, about 6 lines in length, $2\frac{1}{2}$ lines broad, the surface minutely pubescent, and the more or less persistent margins provided with numerous very short recurved hooks ($\frac{1}{4}$–$\frac{1}{2}$ a line in length).—Growing in grassy land among cocoanut trees, Mazatlan and vicinity, January, 1889 (n. 1218 and 1265). These plants having the habit of *M. pudica* L. differ constantly from that species in their smaller heads, and in the characters of the fruit. In M. pudica the legume is ciliate with less numerous, much longer, coarser bristles, which are not at all reflexed. Furthermore, the stipels in M. pudica are green and much less bristle-like.

Buddleia (§ GLOBOSÆ) **Wrightii.**—Shrub: branches and branchlets slender, terete, minutely striate, smooth : leaves thin, lanceolate, sharply acuminate, long-attenuate to a slender slightly margined petiole, serrate, covered on both surfaces with a close and inconspicuous canescent stellate puberulence, green

above, paler beneath, including petiole 4–5 inches long, 1–1½ inches wide, the uppermost smaller, entire: peduncles in pairs, axillary, smooth, 5–10 lines long; heads 5–6 lines in diameter; calyx tomentous, obtusely four-toothed; corolla 1½ times as long as the calyx, hairy within; stamens and clavate entire stigma included.—A "willow-like bush," head of Mazatlan River, January, 1889 (n. 1282). Distinguished from the South American *B. globosa* Lam., *B. polycephala* HBK. and others by its thinner leaves and the absence of the dense ferruginous tomentum characteristic of those species; from *B. connata* Ruiz et Pav. by its narrow petioles, which are merely connected by a line and are not truly connate.

Citharexylum Cinaloanum.—A slender shrub, 4 feet high: branchlets striate, roundish or slightly 4-angled, canescent-tomentulous: leaves ovate or oblong, usually acuminate, rarely obtuse at the apex, acute at the base, entire or with a few shallow teeth toward the apex, pale, nearly glabrous but slightly roughish above, with short canescent tomentum beneath, 1¼–2½ inches long, half as broad; petioles 2–4 lines long: spikes single, terminal, slender, nodding; bractlets minute, subulate; flowers subsessile; calyx campanulate, 1 line long, striate, pubescent, with 5 very short acuminate slightly spreading but not reflexed equal or sub equal teeth; corolla white, pubescent within and without, exceeding the calyx by half; segments erect; fertile stamens four; rudiment minute; style glabrous; fruit dark, 2 lines in diameter.—Mazatlan, January, 1889 (n. 1225). Very nearly related to *C. Berlandieri* Robinson, but differing in its larger, usually more acuminate leaves, its campanulate rather than turbinate calyx with acute instead of blunt lobes, in the erect lobes of the corolla, and the glabrous style; the corolla-lobes in C. Berlandieri being larger and more spreading and the upper part of the style puberulent.

Gray Herbarium, Cambridge, Mass.

Noteworthy anatomical and physiological researches.

CONWAY MAC MILLAN.

Influence of gravity on sleep-movements.[1]

Fischer has attempted in these researches to discover the influence of gravitation upon the positions assumed by nyctitropic organs during the changing diurnal and nocturnal conditions. The method of experimentation adopted was simple. Two groups of cultures were arranged, in one of which plants were placed in abnormal inclinations to the plane of gravity-stimulation, while in the other, the plants were rotated upon the klinostat. By these means it was possible to show that the plants experimented upon could be grouped in two classes: (1) those which continued the nyctitropic movements regardless of the direction from which the force of gravity acted; and (2) those which failed to assume nyctitropic positions in the absence of normal gravity-stimulus. The first group of plants—to which belong Trifolium pratense, Portulaca sativa, Cassia Marylandica, Oxalis lasiandra, Acacia lophantha and others—is named by Fischer *auto-nyctitropic*. The second group, apparently smaller than the first, includes Gossypium arboreum, Phaseolus multiflorus, Lupinus albus and certain Malvaceæ, and is named *geo-nyctitropic*. These experiments, if extended, might be fruitful in explaining some difficult problems in plant positions. It would seem particularly desirable to determine, if possible, for a number of plants, the critical angle at which nyctitropic movements fail to appear. This is a line which might easily be investigated in many American laboratories.

Effects of transpiration and darkness on form.[2]

Wiesner here continues experimentation somewhat along the line indicated by Palladin and others, with reference to the connection between the form of a plant and its rate of transpiration. He has examined more particularly those plants which normally form a basal rosette of leaves, as in the case of Taraxacum, Capsella, Sempervivum, etc. He finds that

---

[1] A, Fischer: Ueber den Einfluss der Schwerkraft auf die Schlafbewegungen der Blætter. Botanische Zeitung, 1890.

[2] J. Wiesner: Formænderung von Pflanzen bei Culture im absolut feuchten Raumer und im Dunkeln. Berichte der deutschen bot. Gesellsch, 1891, p 46.

the behavior of different plants in a saturated atmosphere is by no means the same, but that there may be distinguished at least four types.

(1) The rosette of radical leaves is loosened through lengthening of internodal areas, both in darkness and saturated atmosphere. This is the case in Sempervivum tectorum.

(2) There is no change of shape in obscurity or in a saturated atmosphere. This is the case in Oxalis floribunda and Plantago media.

(3) The plant undergoes dissociation of the radical rosette in darkness but is unaffected by a saturated atmosphere. This is the case in Taraxacum officinale.

(4) The radical rosette is dissociated in the saturated atmosphere but is unaffected by obscurity. This is the case in Capsella bursa-pastoris.

Wiesner holds that in type 1 the internodal elongations are in both cases due to increased transpiration. Type 2 he finds difficult and calls into court that witness of last resort, heredity, saying that there has been produced a *phylogenetischen Entwicklung* which can not be modified by changing conditions in the life of a single culture plant. Type 3 is explained by considering that light retards growth while transpiration has little or no effect, and Type 4 indicates that transpiration may be the condition of extended growth, while light has little influence, or none at all.

It does not seem at all certain that all of these explanations are final. Type 2 could be better explained by some cause separate from those investigated, acting either actively or conservatively, to modify or inhibit the influence of the light and transpiration current. The writer called attention in the GAZETTE of May, 1890, to a peculiar epinastic position of Solanum leaves under certain conditions which, he has since come to believe were principally of modified transpiration. This same plant was afterward examined by Vöchting [4] and very good photographs given of the peculiar epinastic position. The Solanum plant also behaves in an interesting manner in a saturated atmosphere, assuming much the appearance of an etiolated plant. This was recently determined at the laboratories of the University of Minnesota. In a saturated atmosphere the leaves, however, continue to be strongly

[4] H. Vöchting: Laubblætter und Assimilationthatigkeit, Bot. Zeit., vol. 49, no. 9.

epinastic, although exceedingly small. There is also a formation, of course, of chlorophyll, and these differences suffice to distinguish between the etiolated and *hydrolated* plant. The interesting point is the permanent epinasty induced by atmospheric hydrolation; it is quite as marked in the small hydrolated leaves of Solanum tuberosum as in the large normal leaves of the same plant. Along this line further researches would supplement Wiesner's work and probably confirm and extend the investigations of Palladin. At any rate the Solanum tuberosum is recommended as a highly sensitive hydrolitic plant, and its further examination suggested to botanical workers as of much probable interest.

A monograph of plant-torsions.[1]

It is quite impossible to do justice to this voluminous and painstaking record of physiological research in a brief review. Mention will be made, therefore, of but one among the very numerous points of interest. In his researches upon the torsions in plant-organs, De Vries has had occasion to study particularly the Dipsacus sylvestris, a plant prone to exhibit these anomalous twistings of stems and leaves. He has accordingly cultivated the plant for many years in the botanical garden at Amsterdam. In six years, by careful selection, this distinguished investigator has established a variety of the teasel which is so constantly characterized by torsions in the stem and leaves that he proposes for it the name of Dipsacus sylvestris torsus. That these monstrous plants can be so rapidly produced by a systematic process of seed-selection is indeed worthy of note. For figures and descriptions the reader is referred to the article itself, which is one of the two or three most notable botanical works of the past year.

University of Minnesota, Minneapolis.

BRIEFER ARTICLES.

Atriplex corrugata, n. sp.—Diœcious, shrubby at base, much branched, about a foot high, hoary throughout with a dense scurfy pubescence, very leafy: leaves linear-oblanceolate or -oblong, obtuse

[1] Hugo de Vries: Monographie der Zwangsdrehungen. Pringsheim's Jahrbücher für wiss. Botanik, xxiii, pp. 13–206.

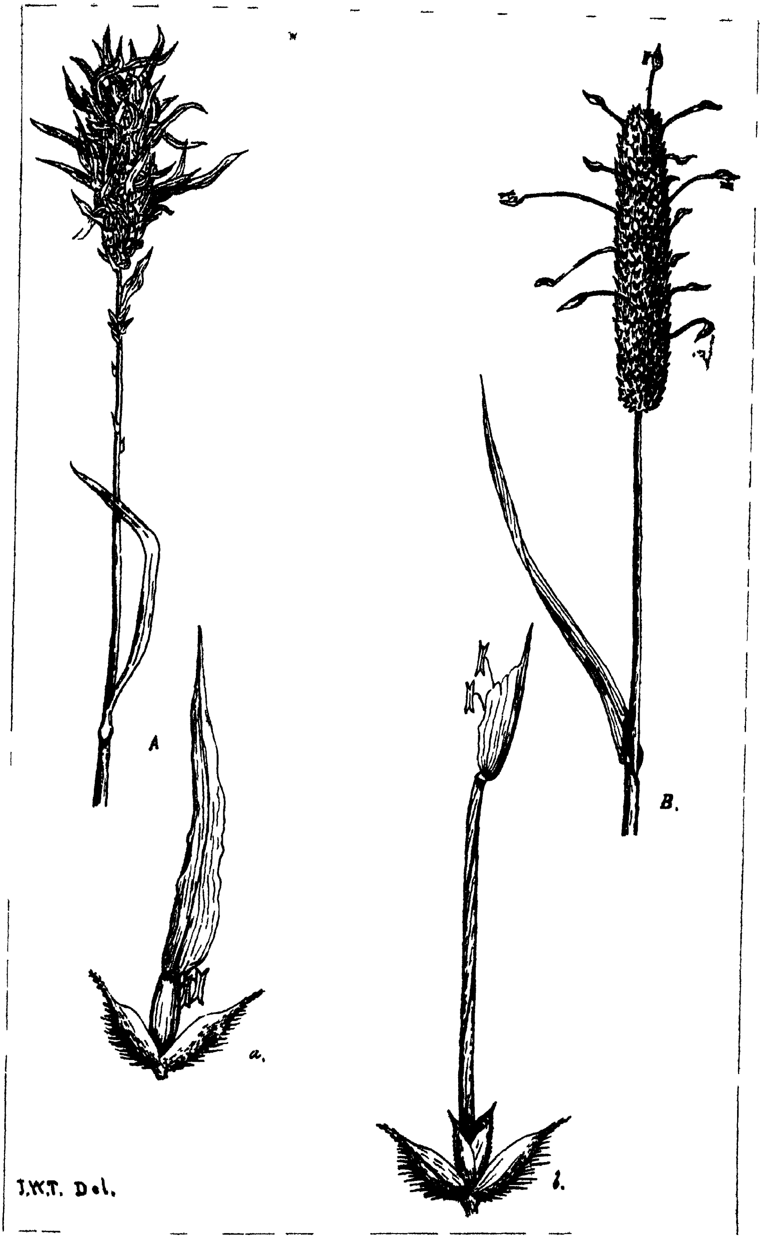
or acutish, entire, 3 to 6 lines long: staminate flowers in short crowded terminal spikes; pistillate flowers in axillary clusters; bracts thick and spongy, 1½ to 2 lines long, obovate, united to above the middle, the free margins above broad and truncate or rounded or acutish, entire, the sides very variously and irregularly appendaged with spongy tubercles or crests which have usually a corrugated appearance when dry.—Nearly allied to *A. Nuttallii.* Discovered by Miss Alice Eastwood at Grand Junction, Colorado, in well formed fruit on 20th May, 1891. Miss Eastwood notes it as the earliest in fruit of several perennial species of the genus growing in the same locality.

RANUNCULUS GLABERRIMUS, Hook.—This common alpine species of the western mountains is much more variable in several respects than the published descriptions would indicate. The leaves vary from broad to narrow, and though the cauline leaves are ordinarily lobed, at least some of them, yet it occasionally happens that all are entire. The plant is as a rule wholly glabrous, but the sepals are sometimes sparsely villous with white hairs, and the achenes are either smooth or finely pubescent. This more pubescent form, as collected by Mr. Siler in southern Utah with entire leaves, was referred by Dr. Gray to *R. Lemmoni*, which species is as yet known only from the original locality in the Sierra Nevada.

RANUNCULUS MACAULEYI, Gray.—Fine fruiting specimens of this rare species have been recently collected by Miss Eastwood in the Elk Mountains above Irwin, Colorado. The achenes are small, in an oblong-ovate head, smooth, somewhat compressed, and beaked with a rather long linear-subulate straight style. The species appears to be well distinguished from *R. Altaicus* by its pilose-ciliate leaves, glabrous linear-oblong receptacle, and longer styles.—SERENO WATSON, *Cambridge, Mass.*

The sterile flowers of Panicum clandestinum.—The past season there was brought into the laboratory by a student a specimen of this species in which the sterile flowers had three well developed stamens. According to Gray's Manual, the lower or sterile flower is "(always?) neutral." On examination of a large number of specimens from this vicinity, it was found that by far the greater number had the lower or sterile flowers staminate. Specimens from Nebraska showed many staminate flowers also. Michigan specimens had the sterile flowers neutral. It was also observed that specimens collected early in the season had a larger number of staminate flowers than those collected later.—THOS. A. WILLIAMS, *State Agricultural College, Brookings, S. D.*

Peculiar forms of proliferation in timothy. (WITH PLATE XXVI.)—In a small plat of Timothy growing on the Experiment Station



TOUMEY on PROLIFERATION

grounds of the University during the past season, a number of specimens showing these two forms of proliferation were found. Such specimens were especially numerous along an irrigating ditch which ran through the plat. This abnormal development was probably the effects of an over-supply of water. The form *A*, I have observed before. It is frequently produced in wet seasons on low and cold soil. In this case the floral glume is changed to a leaf, with other parts of spikelet normal. *a* represents an enlarged spikelet.

In the form *B* the spikelet is much changed from the normal. In a number of specimens there are four glumes, from between the inner pair of which extends a long stipe, generally more or less twisted and surmounted by a perfect flower. In some cases there are but two glumes below, with long stipe and perfect flower as before. In either case the glume above is very large, sometimes changed to a leaf, while the palet is inconspicuous, or there is none at all. *b* represents a spikelet of this form with four glumes below.—J. W. TOUMEY, *Botanical Laboratory, Univ. of Arizona.*

Iris hexagona.—In August, 1889, I collected at Carlinville in south-central Illinois fruiting specimens of an Iris whose species was not at the time determined because of the absence of flowers. In the season of 1890 the flowering period of the species passed without observation. A special watch was kept during the past summer and in early June the plant was taken in full bloom. With the exception of two points, viz., size of capsule and distribution the features of the plant tallied with the description of I. hexagona. Specimens were therefore sent to Dr. Sereno Watson who identified it as above designated. While the known distribution would suggest its occurrence in this state a careful search has found no record of such occurrence.—W. E. ANDREWS, *Carlinville, Illinois.*

EDITORIAL.

OUR READERS are invited to inspect carefully the table of contents and list of contributors which accompany this number. By doing so they will get a comprehensive view of "the high character and variety of the original communications"—to use the commendatory phrase of one of our most eminent friends. The printed pages bear evidence of much valuable research which we esteem it a privilege to publish. Our readers have a large and distinguished company to

thank for whatever of interest and instruction they have gained from the journal during the past year.

THE CLASSIFICATION of the original articles is of some interest. Naturally taxonomy and morphology lead with 44 titles, of which 32 belong to phanerogams and 12 to cryptogams; physiology stands next with 17 (including four entries relating to flowers and insects); anatomy and development have 10; teratology and variations 6, apparatus and methods 4; plant diseases 2; and reports of societies, etc., 5. Making allowance for the various other places of publication the relative numbers of articles probably represent fairly the character of work which is now going on, if we except the study of plant diseases. The economic bearings of this study usually determine the publication of articles on these subjects elsewhere.

WHEN THE great increase in sources of publication is considered it is rather surprising that the supply for a journal covering so wide a field as this continues unabated. The *Bulletins* of the Agricultural Experiment Stations, the *Proceedings* of various societies and academies, the *West American Scientist*, *Zoe*, the *American Naturalist*, the *American Journal of Science*, the *American Garden*, *Garden and Forest* and other similar journals contain many botanical articles; the *Annals of Botany* takes off some of the longer papers; while the *Bulletin* of the Torrey Botanical Club and the *Journal of Mycology* are replete with original articles and summaries of current work. Is there, by reason of these abundant sources of publication, temptation to the sending out of hasty and incomplete work ?

THE EDITORS' LABOR during the year has not been inconsiderable. Twenty works have received extended review, and nearly fifty shorter notices have been written to keep abreast of the "Current Literature" sent to our table for review. Under the heading "Notes and News" have appeared nearly 200 items, giving a great variety of information about current events in the botanical world. This, together with the routine work connected with the regular issuance of the journal, has involved an expenditure of energy which few can appreciate who do not know it from experience. It has been to the editors a labor of love, however. They hope that the readers of the GAZETTE have been helped by it to a wider knowledge and a more zealous study of the science which we all delight to honor.

***

ATTENTION is called to the announcements on the last page of the cover.

CURRENT LITERATURE.

Minor Notices.

EVER SINCE homologies were known to exist between heterosporous pteridophytes and phanerogams the genus Isoetes has been one of peculiar interest, for it has seemed of all known pteridophytes most nearly related to phanerogams. Dr. Douglas H. Campbell, whose work in the life-histories of pteridophytes is well known, has made a careful study of the life-history of a species of Isoetes (I. echinospora, var. Braunii), and has published his results in *Annals of Botany* (Vol. V. no. 19, Aug. 1891), illustrated by three double plates. He has traced the development of the male prothallium, the macrospore and female prothallium, and the embryo as to its leaf, root, and foot). While the details of technique are both interesting and instructive, for the subject was beset with unusual difficulties of manipulation, the interest naturally centers about the conclusions with regard to the relationship of Isoetes. The genus has been ordinarily placed among the Lycopodineæ, although Vines has called attention to its closer relationship to Filicineæ, to which latter view Campbell also inclines, and his results seem to bear him out in this view. However, Isoetes still seems widely isolated at best, and its relationship to Filicineæ, while nearer than to any other pteridophyte group, may still be considered a somewhat distant one. While nearest to the Filicineæ, it still seems to have closer homologies with phanerogams than any other pteridophyte. Campbell has succeeded in making the very important point that these homologies are with the monocotyledons rather than with the gymnosperms, thus emphasizing the notion of the independent origin of the angiosperms from the pteridophytes and the further notion of the origin of monocotyledons from the Filicineæ through such forms as Isoetes. Of course the intervals are still far too great for definite conclusions, but these results with Isoetes are full of suggestions for future investigations.

THE SEVENTEENTH contribution from the cryptogamic laboratory of Harvard University is by William Albert Setchell, under the title "Concerning the life-history of Saccorhiza dermatodea." It is a reprint from Proc. Am. Acad. XXVI., distributed September, 1891. It deals with a very complex and polymorphous member of the Laminarieæ. Dealing first with its discovery by De la Pylaie, its distribution, habitat, and season, the author treats its morphology under four periods, each characterized by some important changes in development. Then follows a complete account of the histology of each of these per-

iods, and then a discussion of relationships to certain specific forms and other Laminarieæ in general. That the species is a polymorphic and somewhat confusing one may judge by the fact that in literature it appears under five generic names with nine different specific combinations.

IN AN ARTICLE entitled "The vitality of some annual plants," reprinted from the October number of the American Journal of Science, Mr. Theo. Holm instances a number of annual plants of which he has found individuals having arrangements for living over winter.

MR. HENRY EGGERT has published a catalogue of the Phanerogams and Pteridophytes in the vicinity of St. Louis, the radius being about 40 miles. This is the first complete list of this interesting region since Geyer's Catalogue of 1842. The list contains about 1100 species, and Mr. Eggert's long and patient study of the St. Louis flora insures a list both complete and accurate.

NOTES AND NEWS.

DR. AUG. F. FOERSTE sailed for Europe the middle of last month, and is now at the Collége de France, Paris.

ON PAGE 273 the GAZETTE tried say that Mr. T. *Kirk* of Wellington, New Zealand, was preparing plants of that country for distribution at *45 shillings* per century.

DR. ARTHUR MEYER has been called to the professorship of botany in the University of Marburg. Dr. F. G. Kohl, heretofore *privat-docent*, has been made assistant-professor.

DR. HERMANN HOFFMANN, professor of botany in the University of Giessen, is dead at the age of 72. Plant climatology, geography and phænology are the branches to which he gave especial attention. Indeed the latter subject owes most of its present development to his labors.

THREE of the six established scholarships for garden pupils of the Missouri Botanical Garden (St. Louis) are to be awarded before the first of April next. Those who desire full information concerning the great advantages offered by these scholarships, and the conditions upon which they are awarded, should address the Director, Dr. William Trelease.

---

[1] pp. 292—309, with plate XIII.

GENERAL INDEX.

*** The more important classified entries will be found under the following heads: *Diseases, Geographical Distribution, Hosts, Journals, Necrology, Personals, Reviews*

*** Names of synonyms are printed in *Italics;* names of new species in **bold-face**; † signifies death.

A

B

C

D

E

K

L

M

N

O

P

Q

R

INDEX TO AUTHORS.

ERRATA.

p. 22, line 7, for hyhæ read hyphæ.
p. 26, line 2, for inside read method.
p. 26, line 9, for Sigmiodeomyces read Sigmoideomyces.
p. 26, line 11, for when read where.
p. 62, line 3, for Colletotrichium read Colletotrichum.
p. 76, line 9 from bottom, for inclines read inclined.
p. 77, last line, *dele* not.
p. 100, line 12, for oxylepsis read oxylepis
p. 107, line 10, insert S. after 17.
p. 137, line 3 from bottom, for sap read sop.
p. 138, line 3, for sap read sop.
p. 138, line 20, for savory read curry.
p. 139, line 12, for mashed read washed.
p. 139, line 4 from bottom, for ocara read ochra.
p. 139, footnote 41, for Lechium read Sechium.
p. 140, line 2, for pie read pea.
p. 140, line 5, for roots read nuts.
p. 140, line 15, for Lucca read Lucea.
p. 147, line 18 from bottom, *dele* n. sp.—The species was previously described in the *West American Scientist.*
p. 149, line 18 from bottom, for sasisfactory read satisfactory
p. 188, line 22, insert Station after Experiment
p. 199, line 16 from bottom, for Pirus read Pinus.
p. 210, line 13, insert translation of before Strasburger's.
p. 213, make $\begin{cases}\text{syncarpous}\\ \text{apocarpous}\end{cases}$ follow compound.
p. 240, transpose the two footnotes.
p. 273, lines 6 and 9 from bottom, for King read Kirk.
p. 273, line 6 from bottom, for $4.50 read 45 sh.
p. 289, line 7, for gossypii read Gossypii.

THE

BOTANICAL GAZETTE

EDITORS

JOHN M COULTER, University of Indiana, Bloomington, Ind
CHARLES R. BARNES, University of Wisconsin, Madison, Wis
J C ARTHUR, Purdue University, Lafayette, Ind.

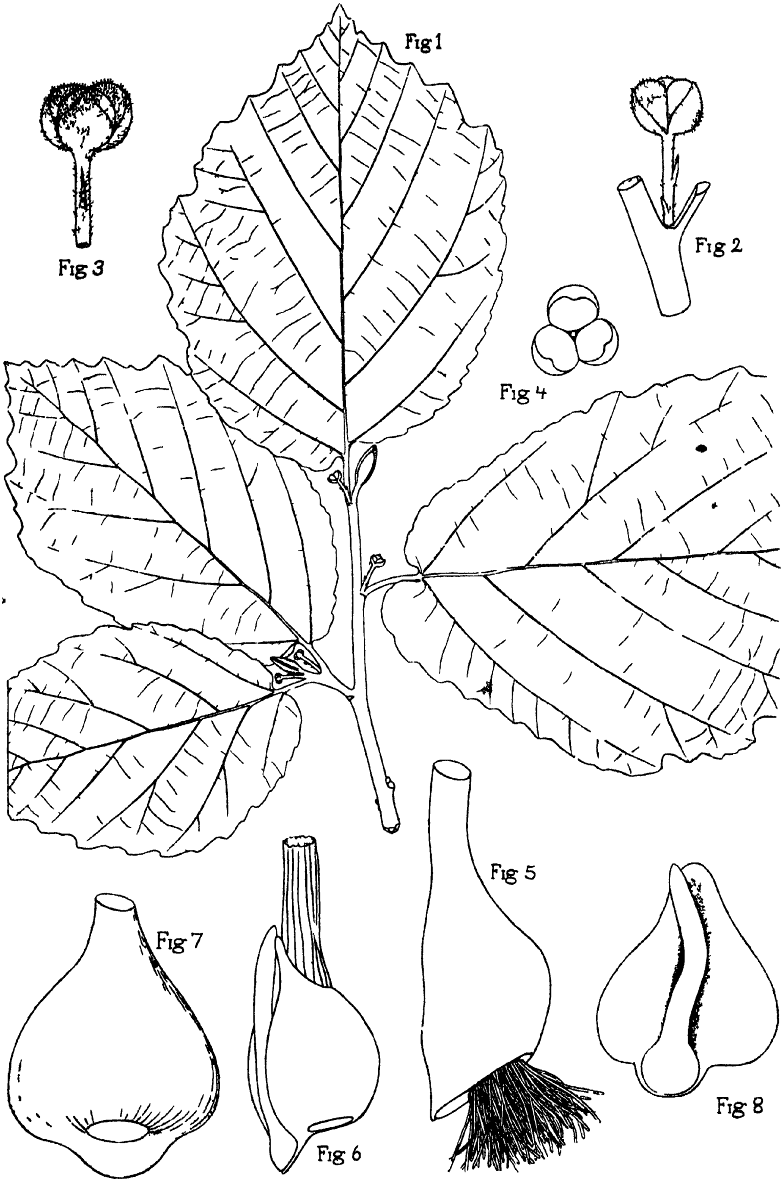
VOLUME XVII

1892
BLOOMINGTON, INDIANA
PUBLISHED BY THE EDITORS

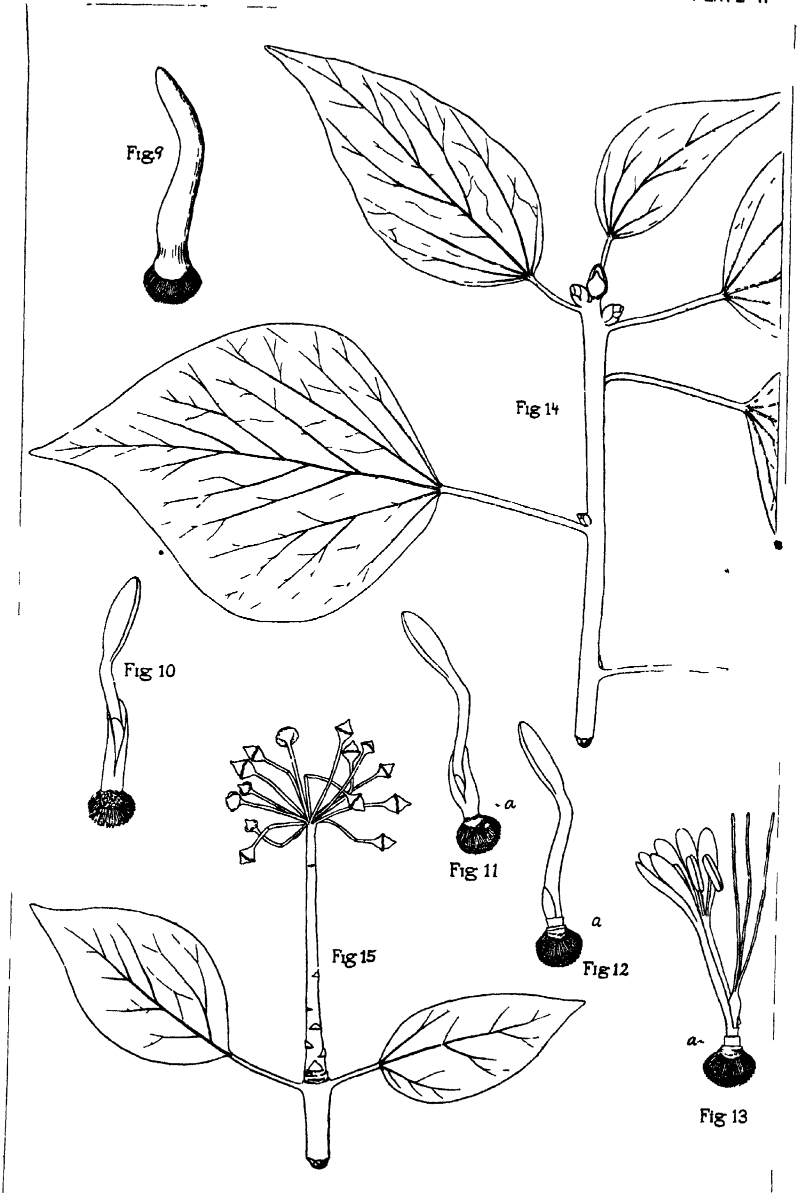
TRACY, GIBBS
AND COMPANY,
PRINTERS, MADISON WIS.

TABLE OF CONTENTS.

BRIEFER ARTICLES—



FOERSTE on FALL BLOSSOMING



FOERSTE on FALL BLOSSOMING

BOTANICAL GAZETTE

JANUARY, 1892.

On the relations of certain fall to spring blossoming plants.

AUG. F. FOERSTE.

(WITH PLATES I AND II.)

Most spring flowering plants in the more northern latitudes begin the development of their floral organs already during the previous year. The following table will give a very good idea of the extent to which this development has taken place in a series of plants collected near Clarendon, Vermont, during the week from the twenty-second to the twenty-eighth of August. In this list are inserted two plants: *Cypripedium parviflorum* Salisb. collected near Ludlow, Vermont, on the twenty-seventh of September, and *Chimaphila maculata* Pursh, found near Andover, New Jersey, on the ninth of October. The first column indicates whether the scaly winter-buds are subterranean (S), subaerial, or chiefly covered with fallen forest leaves or surrounded by moss (SA), or aerial (A). The second column gives the regular flowering season. The third records the length (in millimeters) attained by the flower cluster at the dates when examined. In the case of *Arisaema triphyllum* Torr. the length of the spathes was given instead (S). The fourth column records the size of the largest flower bud in these clusters. In two cases measurements were not recorded (d).

Hepatica acutiloba DC	S	Mh. Ap	——	1.50
Thalictrum dioicum L.	S	Ap. My.	2.3	.42
Actæa alba BIGEL	S	My	d	d
Actæa spicata, var. rubra MICHX	S	My.	2.5	.50
Caulophyllum thalictroides MICHX	S	My.	2.5	.83
Waldsteinia fragarioides TRATT	SA	Jn.	2.7	2.00
Mitella diphylla L.	S	My. Jn	.8	.25
Gaylussacia resinosa TORR. & GR.	A	My. Jn.	.8	.17
Vaccinium Pennsylvanicum LAM	A	My. Jn.	——	1.00
Epigæa repens L	SA	Ap. My.	7.5	2.50
Pyrola elliptica NUTT	A	Jn. Jy.	.8	.25
Pyrola secunda L.	A	Jy.	.8	.33
Chimaphila maculata PURSH	A	Jn. Jy.	.7	.25
Asarum Canadense L.	SA	My. Jn.	——	2.50

Arisæma triphyllum TORR	S	Ap.	S 2.5	d
Orchis spectabilis L.	S	My. Jn.	6.3	2.50
Habenaria viridis, var bracteata REICH	S	Jn	4.5	2.00
Habenaria orbiculata TORR	S	Jn Jy.	4.5	2.00
Goodyera pubescens R BR	A	Jn Jy	.5	.10
Corallorhiza multiflora NUTT	S	Jy Aug	3.6	1.50
Cypripedium parviflorum SALISB	S	My. Jn	——	8 75
Trillium erythrocarpum MICHX	S	Ap. My	——	5.50
Clintonia borealis RAF	S	Jn	3.0	1.75
Polygonatum biflorum ELL	S	Ap My Jn	3.0	.75
Smilacina racemosa DESF	S	My Jn	2 5	.33

In Thalictrum dioicum the inflorescence was in a more advanced state of development than the leaves. The inflorescence of Waldsteinia fragarioides lies in the axil of the upper scales of the scaly bud, or of the lowest succeeding leaf. That of Mitella diphylla has a scaly covering of its own, in addition to the scales of the winter bud in general, to which it stands in the relation of a lateral bud. The inflorescence of Gaylussacia resinosa and Vaccinium Pennsylvanicum is found in the terminal and upper axillary buds That of Pyrola elliptica, Pyrola secunda, Chimaphila maculata, and Goodyera pubescens is enclosed in a scaly bud which usually lies at the center of a cluster of leaves terminating the apparently flowerless stem; occasionally these buds lie in the axil of one of the upper leaves of the flowering stem.

This early development of the flower buds of the next season permits their ready appearance in spring. It will be noticed, however, from the preceding table that even flowers blooming as late as July and August may develop their buds during the previous summer. Occasionally plants mistake the cold winds of the earlier part of October for winter, and the warm, sunny days of Indian summer for spring. In that case the flower buds prepared for the succeeding spring are rapidly developed and perfected, only to be killed off again by the wintry winds of the following months, so that they fail to ripen their seeds. In addition to the list of plants enumerated at other times, the wild strawberry, *Fragaria Virginiana* Ehrh., was very frequently found in blossom this fall, so that thousands of flowering specimens could have been collected.

In quite a number of cases, when the flora of the whole world is drawn under consideration, plants which used to flower in the spring only have taken up the habit of flowering in the late fall, and have succeeded in ripening their seeds in spite of this habit. They were able to flower already in

the fall owing to the advanced state of development of their buds at this season, even before the habit of flowering in the fall set in. It was only necessary to secure means of perfecting their fruit. To illustrate these phenomena the writer has chosen the three plants having this habit which are most familiar to himself: *Hamamelis Virginiana* L. of the United States, *Hedera Helix* L., and *Colchicum autumnale* L., of Europe, a shrub, a vine and an herbaceous plant respectively, belonging to widely different families.

Hamamelis Virginiana, the witch hazel, usually flowers in October or November, but occasionally, after a cold fall, not until the ensuing spring. The flower buds appear very early, almost simultaneously with the leaves, perhaps, but search was not made for them at so early a date. The specimen figured was collected early in July. It will be noticed that the flower clusters are axillary (fig. 1.) The clusters consist usually of three buds closely arranged around the pointed termination of the little axillary stem (fig. 4.) Each bud is subtended by a small appressed bract which reaches about the same height as the buds; these bracts therefore do not offer full protection to the buds within (figs. 2, 3, 4.) Possibly the bracts completely enclosed the clusters formerly, when the witch hazel flowered only in spring. The defect is remedied by the subcoriaceous character of the exposed portions of the calyx, and the hairy covering to both the calyx and the subtending bracts (figs. 2, 3.) The early development of the flower cluster, its long period of extremely slow development, the subcoriaceous character of the calyx and of the bracts, the hairy covering of the same, all indicate rather a plant which once was obliged to protect its blossoms for spring flowering, than a fall plant which is developing into a spring blossomer, or a summer plant becoming a fall blossomer. The fruit remains small during the winter. It is very coriaceous in character, and in addition has a protection of closely-fitting hairs. Its real development begins first in spring, and the seeds are usually not ripened until late summer.

Hedera Helix, the European ivy, usually flowers in October, but in more southern countries as early as September. The writer has seen no record of its ever blossoming in the spring. It may therefore be assumed to be a plant which has entirely gone over from spring to fall blossoming. The young branches of the ivy do not all cease growth at very nearly the same

time, as is the case with so many trees and shrubs, but some of them are terminated with scaly buds, while others continue growth for several months, and may perhaps even have their tips winter-killed. Terminal scaly buds were noticed at Heidelberg, Germany, as early as June 1, although the date of their first appearance is uncertain. They had every character of an aerial scaly bud destined to survive the winter (fig. 14.) Perhaps the scales were a little too green, not at all coriaceous enough, but formerly while the plant was spring blossoming the case might have been different. Not a trace of an inflorescence was noticed in these buds until the first days of July. Near the middle of the month the inflorescence was quite large in all of the flowering buds, and during the last days of July the inflorescence was rapidly pushing its way out of the scaly bud into the open air, and expanding preparatory to fall flowering. The upper scales of the scaly bud are usually carried up on the common peduncle of the inflorescence to a greater or less extent (fig. 15.) The formation of a scaly bud at an early period, at a time when the leaves have almost reached their full growth, and the quite slow gradual development of this bud, are characters perfectly incomprehensible in a summer-flowering plant, taking up the habit of blossoming in the fall, but are readily understood if the plant be supposed to have changed from a spring to a late autumn-flowering plant. The ivy does not ripen its fruit until the ensuing spring. Its character during winter was not noticed.

Colchicum autumnale usually flowers in October, but when the meadows have been inundated in the fall, or when the fall has been unusually cold, it does not blossom until spring. The first trace of a flower was noticed at Heidelberg, Germany, about the middle of July, but it had evidently been in existence for perhaps a week. At the end of the month the flower bud was still minute. The specimen figured belongs to a much later date, just before the flowering season, and represents the developing blossom. As a means of presenting the morphology of this plant it is much better adapted. The bulb has one side considerably flattened, and the other decidedly convex (fig. 5); the lower portion of the bulb slopes obliquely downwards from the convex surface until it meets the flattened surface at an acute angle (fig. 5.) It consists of two withered, brownish scales enclosing the base of

the flowering stem which has developed into a corm. Removing the scales this corm is seen to give form to the bulb (fig. 6.) Along the middle of the flattened face there is seen to be a broad groove, and at its base there has been developed a sort of lobe. To this lobe is attached a bud (fig. 8), which is really in the axil of the inner of the two withered sheathing scales just removed. If at a sufficiently advanced stage of development the thin cuticle at the base of this bud be removed it will be found to completely cover a large bundle of little roots, many of them already 3 mm. long (fig. 9), ready to take the place of the old roots when their work is done (fig. 5.) A reference to the figures will show that by a more rapid development of the tissues just above the roots on the non-attached side of the bud, this bundle of roots becomes central in the oblique base of the future bulb (figs. 5, 7.) The first scale is a closed sheath (fig. 9.) The second scale is a sheath only at its base, but the sheathing portion elongates considerably during subsequent growth (fig. 10.) The first leaf is also slightly sheathing at the base (fig. 11), and the second leaf is not sheathed at all (fig. 12.) In the plant figured the floral envelopes, the stamens, ovary and styles are all already considerably developed (fig. 13.) It will be noticed that a small internode exists between the second scale and the first leaf (*a*, figs. 11, 12, 13.) When the plant begins to flower in the fall the bud pushes its way along the afore-mentioned groove (fig. 8), and up between the withered sheathing scales to the air. This is mainly caused by the growth of the scales of the bud (figs. 9, 10) of the perianth tube, and of the styles of the flower (fig. 13.) The leaves and ovary do not appear until the next spring. At this time the internode between the second scale and the first leaf (*a*, figs. 11, 12, 13) develops rapidly and carries both the leaves and the fruiting ovary out into the open air, thus solving the question of the proper wintering of the fruit. The nondevelopment of the leaves and fruit until the year following the flowering season is certainly not a character such as might be expected from summer flowering plants turning gradually into autumn or spring flowering ones. However, the appearance of the flowers before the leaves is readily intelligible if the reverse change from a spring to a fall blossomer be supposed, since this is not at all an uncommon occurrence in spring flowering plants, and such a forced development of the flower buds before the lower

leaves is often already indicated in the scaly bud of spring flowering plants, during the previous year. It is only one of the extreme results of that tendency which certain plants have of flowering as early as possible, and hence of becoming spring and occasionally fall blossoming plants.

Late fall flowering plants may be divided into two classes. First, those which have developed from summer flowering plants by the increase in the number of internodes, with their appendages, or the gradual retardation of growth. Second, those which have developed from spring blossoming plants by the premature development of buds destined to flower first during the ensuing spring. The first class never had any need of protection to the flower buds against wintry weather, and hence should form no scaly buds for the flowers; moreover, since their flowering buds never lay dormant during the winter season, they should show no traces of a period of rest, between the first growth of the flowering buds and their final development. The second class should preserve traces of a scaly bud, and should show traces of great retardation of growth between the first rapid starting of the flower bud and the final rapid completion of the same, as reminiscences of their former almost dormant state during winter. Moreover, the first class should find all their nearest relatives among the summer flowering plants, and the second class should have their nearest relatives among those which flower immediately in the spring. This is the case with the list of fall flowering plants at hand; since, however, this list is only collected from literature, and the writer has not personally examined the plants in a state of nature, a further discussion of the same is omitted for the present.

That spring blossoming plants are the offspring of summer flowering plants, and that they have obtained the power of flowering so early by decreasing the number of their internodes and by starting the development of their flower buds during the previous year is a well known fact. This is further indicated by the fact that spring plants grade by intermediate species into early and late summer flowering plants. If there are related species flowering in the fall, and they belong to the first class above described, a series of intermediate early and late summer flowering plants is sure to be observed. If a spring flowering plant has close relatives among fall blossomers, and none whatever during the inter-

mediate summer months, the development of the fall flowering species from those blooming in spring, in the manner described above, is very likely to be the case. As a matter of fact, most fall blossoming plants belong to the first class.

The ideal time for the flowering season of plants is in late spring and early summer. In the struggle in the race for existence two tendencies set in. The one is to secure advantage over surrounding plants by increasing in size and thus securing more light, air and room for the development of their own flowers. This tends to result in late summer and in autumn flowering plants. The other is to gain advantage over other plants by the earlier blossoming of their flowers, or by blossoming before the foliage of the trees overhead, or that of the surrounding plants can cut off the light or otherwise interfere with their development. This tends to produce spring flowering plants. Autumn blossoming plants, which are the result of the extreme development of the latter principle, are in one sense of the term freaks of nature. The writer believes, however, from a study of the literature of the flowering seasons of plants, that this freak of fall flowering has become a permanent one for a greater number of plants than botanists usually suppose, and that there should be recognized a distinct division of fall flowering plants whose nearest relatives are with those that blossom in the spring.

If the principle that spring flowering plants are produced from summer flowering plants by the reduction of their internodes, be kept in view, it is evident that this result might be attained through the struggle for light and room *in situ*. The same result would be attained if summer plants should migrate temporarily toward the north, or up mountain sides, since the shortening of the period favorable for vegetation might operate in reducing the number of internodes and in hastening the perfection of the flowering buds, while after these alterations had become permanent, a return to more congenial climates would favor earlier, possibly spring blossoming. Essentially the same conditions would exist *in situ*, if the colder climate of a glacial period should come down from the north. The reduction of the period favorable for floral development would again operate in reducing internodes and in hastening the development of floral buds. The retreat of glacial climate would favor earlier blossoming, in many cases spring blossoming. Plants which were spring blossomers in the far

north before the advance of the glacial climate might be forced during its advance to migrate southward to maintain their existence, and on the retreat of the same might climb up the mountain sides and remain there as witnesses of their former migration. Moreover, plants which formerly had been spring blossomers might during the advance of glacial climate maintain themselves *in situ*, by adapting themselves to the more rigorous climate. On the retreat of the glacial conditions they might have so altered their habits as to be able to maintain their existence only on mountain tops or in the distant north. Migration to these places would therefore set in. It is probable that all these causes have operated in the production of spring blossoming plants. It is impossible to tell in the case of individual plants, to which method their production is to be ascribed. It is sufficient for the present to remember that nature has many means of accomplishing the same result.

Heidelberg, Germany.

The effect of mechanical movement upon the growth of certain lower organisms.

H. L. RUSSELL.

The effect of external agencies upon the growth of organisms has been thoroughly studied in several of its relations. Of these influences, the relation of temperature to growth, is perhaps the best understood. Other factors, such as the effect of light, of increased and diminished pressure, have also been made the subject of more or less careful study.

To the effect of mechanical movement upon the growth, less attention has been given, nor have the results already obtained been entirely in harmony with one another.

In the following experiments an attempt has been made to find out, (1) what influence mechanical movement has upon growth of cells in regard to size and form; (2) its influence upon growth in regard to increase in number.

The method used in the experiments was as follows:

Two 500 c. c. distilling flasks were half filled with nutrient solutions, sterilized and then inoculated with a small quantity of the germ to be studied. After thoroughly distributing the

inoculated "seed" by shaking, a number of samples were taken and from these the number of cells in a certain volume was determined by means of Nâchet's hæmacytometer. By means of this apparatus equal known quantities were used each time. A number of counts, usually not less than one hundred, were made, so as to make the average as accurate as possible. At first each flask was inoculated and counted separately, but it was soon found that more accurate results could be secured by determining the number present per unit of volume for the whole amount of the fluid and then dividing it into two equal amounts. The danger of contamination from outside influences is of less consequence than the difference in units of volume which inevitably occurs where the determinations are made separately of the amount of "seed" added to each flask. After counting, the two flasks were subjected to exactly the same conditions, with the exception that one of them was kept in a state of constant agitation.

This was secured by the rotation of a vertical shaft to which was attached a horizontal bar. This bar in its rotation struck and lifted the flask, which on its return swing struck against an upright standard. The stroke by the rotating bar and the sudden checking of the movement of the flask kept the fluid in a state of constant agitation. All points of contact of the flask with the bar and standard were sheathed with rubber to prevent breaking. The power was furnished by a small reaction water wheel and was transmitted by a belt from a pulley on the motor to a cone pulley fastened to the upright revolving shaft. This cone pulley enabled me to vary the rapidity of the revolution of the horizontal arm at pleasure.

After allowing a certain time for growth, samples were withdrawn and counted in the same way as before. The number per unit of volume at the close of the experiment divided by the number per unit of volume inoculated as "seed" gives the ratio of increase for each flask. As a check, the solution was sometimes filtered and the organic substance carefully collected, dried, weighed, and the ratio thus determined. For this, the ash constituent of the cells can be neglected without interfering materially with the accuracy of the results.

In the majority of the experiments, *Monilia candida*, a yeast-like germ capable of inducing alcoholic fermentation in most sugar solutions, was used for the tests. Two other

germs, *Oidium albicans* and *Saccharomyces mycoderma,* were also used in various cases to confirm results.

To determine the effect of movement upon the size and form of the cells, an experiment was made with Oidium albicans in a bouillon culture. This germ when grown in this culture medium in the ordinary way forms two types of cells, one of which is a long, slender, hypha-like filament, and the other, a short, oval, or oblong yeast-like cell. As a rule, the growth mass is more or less gelatinous, the jelly-like consistency being due to the intimate intermingling of the elongated cell type. Where the short type of cells prevail, the vegetative mass in the bottom of the flask is of a more sandy nature. Two flasks were inoculated with this germ and subjected to similiar conditions except that one of them was kept in a state of constant movement while the other was left undisturbed.

The results obtained were as follows: in the still flask, the two types of cell structure were present in the usual proportions, and a wide variation was found in the yeast-like cells. These varied from $4 \times 8\ \mu$ wide to $7 \times 14\ \mu$ long. In the shaken flask no true hyphal filaments were found, such as were present in ordinary cultures. The nearest approach to true filaments were several chains of 4–6 slightly lengthened cells. The cell-contents did not differ materially in samples taken from each flask.

Much less variation in size was found among the cells of the shaken flask than in the other one.

The experiment was repeated with Saccharomyces mycoderma, a mycelium-building yeast. With this germ, the time of incubation was extended until quite a thick veil or membrane had formed over the surface. The still flask showed two types; one a submerged form, slender in outline, about $0.85 \times 2.25\ \mu$, and the other a surface form with vacuolated contents and plumper outline, averaging $1.2 \times 2.5\ \mu$. In the flask which was kept in motion there was a greater variation found in size, but that was owing to the large number of young daughter cells that had broken away from the mother cells before maturity. The mature cells were quite uniform in size, broadly oval in form, and almost all highly vacuolated. The average size was $1.25 \times 2.25\ \mu$.

From the above experiments it would seem, first, that incessant movement tends to prevent the formation of true hyphal filaments, although elongated types of cells are found;

second, that with the germs forming torula-like cells but little difference in size and shape can be produced. What difference there is seems to be caused not so much by the agitation of the fluid as by the exposure of the cells more freely to the influence of the atmosphere. When submerged the cells grow slender, with homogeneous contents, while the surface-grown forms were highly vacuolated and more broadly oval. The cells from the shaken flask agree in all essentials with those grown at the surface of the still flask, except that they averaged somewhat larger in size.

The second series of experiments bears upon the influence of mechanical movement upon the increase of cells. Horvath[1] conducted a series of experiments upon bacteria and their relation to movement, in which he found that mechanical movement interfered materially with the growth of the germs. From this he made the sweeping generalization that movement had a retarding influence on the growth of all lower organisms. Hansen[2] investigated the subject in connection with his work on yeast (*Saccharomyces cerevisiæ*) and found the reverse to be true. The germs increased two to three times faster when agitated than they did when grown at rest. He concluded that it was the agitation of the cell itself, aided possibly by the more minute subdivision of the nutritive materials, that enabled it to increase more rapidly. The introduction of air into the fluid by the apparatus he used was so little that he thought this point was not of much importance.[3]

In the following synopsis of results, A in all cases represents the culture agitated and B the one that grew undisturbed.

NO. OF EXP	KIND OF GERM	HOURS OF GROWTH	NO OF GERMS PER UNIT OF VOLUME		PROPORTION SHOWING RELATIVE INCREASE IN NO. OF CELLS.	RATIO BETWEEN A AND B.
			BEFORE EXP.	AFTER EXP.		
AI. BI.	Monilia candida	94	16 9+	2332 1618	1 138 1: 95	1.45+
AII. BII.	Oidium albicans.	48	4 67+	1262 610	1.270 1:130	2.0+
AIII. BIII.	Monilia candida.	70	24.4+	1087 767	1: 44+ 1. 31+	1.41+

[1] Horvath: Pfluger's Archiv f. d. ges Phys. XVII, 125.
[2] Hansen: Medd. fra Carls Lab, I, 271.
[3] Hansen: Hypothèse de Horvath, Medd. f. Carls. Lab., I, 96, French résumé.

The culture solution used in all cases was a 10 per cent. solution of grape sugar to which 1 per cent. peptone had been added. The above results indicate without exception that those germs which were agitated increased from 1.4–2 times as fast as those grown undisturbed. As a check upon the counting process, determinations of the dry matter present were made by chemical analysis at first.

Exp. III, which showed a ratio between A and B of 1.41 by the counting process gave by chemical analysis the following result. Amount of organic matter formed in A_{III} 0.1778 gm.; in B_{III} 0.1293 gm. Ratio between A and B 1.37+. This proves that the counting process is reasonably exact as it agrees quite closely with the chemical analysis. This is only true however where there is general uniformity in size of the cells.

The amount of alcohol which was produced by this germ when subjected to these different conditions, was also determined in a number of cases. In every case where this was made, a considerable increase in amount of alcohol formed was found in the undisturbed culture (B) over the agitated culture (A). It would seem then that agitation exerts a favorable influence upon the formation of cells but a retarding effect upon the products of fermentation. Both of these processes, growth and fermentation, depend directly upon the kinetic energy of the plant organism. Where katabolic processes are manifested more strongly in fermentative action there seems to be less energy used by the plant in growth. The data of the two following experiments with Monilia candida, giving the highest and lowest proportions found by analyses, illustrate this point.

NO. OF EXP.	ALCOHOL FORMED.	INCREASED GROWTH OF SINGLE CELL.	RATIO.
A_V B_V	1 6% 3 2%	335 109	
Proportion	1 : 2 :: 3 07 : 1		6 14
A_{VI} B_{VI}	3 2% 3 8%	44 31	
Proportion	1 : 1 18 :: 1 41 : 1		1 66

It will be noted that while no uniformity seems to exist in the ratio, the *amount* of *fermentation products* of the cells in B is *always* greater than in A, while the *amount of organic matter* formed stands in an inverse relation.

We may now ask what is the cause of this increased rapidity of growth when agitated. The experiments detailed above allowed considerable aeration during the movement and as this factor seemed most prominent, the experiments were repeated in such a way as to increase the aeration and diminish as much as possible the movement of the fluid. If aeration increases the growth of the organisms, there should be an increase in the ratio between A and B.

Exp. I. An Esmarch's coiled glass tube, such as is used in bacteriology for air determination in fluid cultures, was inoculated with Monilia candida and air drawn slowly through the coil by the aid of an aspirator. The small bubbles of filtered air slowly travel the spiral, so that a considerable quantity of oxygen ought to be absorbed by the liquid. In this way aeration is considerably increased while the movement of the fluid is much reduced. At the end of 42 hours growth, it was found that the germs which were aerated had increased 2.5 times as fast as the non-aerated culture.

Exp. II. A 500 c.c flask was partially filled with a nutrient solution and inoculated with freshly grown Monilia candida. The mouth of the flask was closed by a triple-perforated sterilized rubber cork. In two of the openings, glass tubes were inserted and the lower ends were drawn out into fine points. The third opening was closed by a bent open tube, the outer end of which was directed downwards. These glass tubes were closed with cotton-plugs and sterilized before being put in place. The two capillary tubes were connected to the blast of a filter pump and thus a stream of filtered air was forced into the fluid culture. The fine bubbles of air rising to the top of the fluid escaped through the bent exit tube. In 30 hours there was found to be 2.2 times as many cells per unit of volume in aerated flask as there were in non-aerated.

Exp. III. In both of the preceding experiments aeration was increased as much as possible while the movement was lessened. In this experiment the reverse order was followed. A thick glass tube was sealed at one end and at 5 cm. distance from this end, a large bulb capable of holding 300 cc.

was blown. In this culture bulb was placed some coarse sterilized quartz sand. The longer open arm was closed with cotton. The vessel was filled with culture fluid so that the bulb and a portion of the open arm was entirely filled. This apparatus was connected with the motor and so arranged that it revolved in as nearly a horizontal position as possible. The coarse sand inside acted as a distributor of the motion to the fluid causing it to be agitated thoroughly.

In this way the maximum movement was obtained with a minimum of aeration; the only chance for aeration being through the small opening of the open arm. Cultures of Monilia candida grown for forty hours and treated in this way had 1.4 times as many cells as those grown in undisturbed flasks.

It is practically impossible to get a considerable movement of the liquid without more or less aeration and the converse is equally true, but where aeration was increased in greater proportion than movement, as in Exp. I and II, we find the percentage of increase of cells and consequently of organic material to be much greater than in Exp. III, where aeration was diminished relatively more than movement.

This factor of aeration seems to be the predominant one although it is possible that the increase is not due to the action of any one factor alone. More intimate division of nutritive materials and the constant presentation of fresh food material to the surface of the plant cell probably aids in the increased growth.

Summing up the points discussed into concluding sentences, we may say that:

1. The form and size of fungal cells is but little influenced except in the case of hyphal filaments which seem to form with difficulty when subject to constant movement.

2. Constant agitation affects very strongly the increase in number of cells formed and consequently the amount of organic matter produced. The increase by growth in agitated cultures as compared with still-grown cultures ranges between wide limits but is usually 200–300 per cent.

3. The amount of fermentation products, as determined by the alcohol formed, seems to stand in an inverse ratio. All cultures so tested showed uniformly less alcohol in agitated than still cultures.

4. The cause of this more rapid cell-multiplication by mechanical movement seems to depend upon aeration of the

culture, the cells growing more rapidly in contact with atmospheric oxygen than when submerged.

5. While this appears to be the chief factor, other elements such as better conditions of nutrition, etc., probably enter in as less important factors.

These researches were carried on in the biological laboratories of the University of Wisconsin.

Baltimore, Md.

Noteworthy anatomical and physiological researches.

Apical areas in seed plants.

The copious researches of MM. Van Tieghem and Douliot[1] on the origin of endogenous members in the vascular plants, published in the *Annales des Sciences Naturelles Botanique* during 1888, will be remembered by all students of contemporary botanical literature. The conclusions arrived at regarding the apical cells of monocotyledons and the single apical cell of the Archispermæ (gymosperms) are well known, having already found their way into at least one of the more prominent text-books. It is, by no means universally admitted, however, that the proof of apical cells in these groups of plants is decisive. The older literature on the subject was given in résumé by Dingler[2] in 1882, but since that time the important works of Karsten,[3] DeKlercher,[4] Groom,[5] Korschelt,[6] and others have appeared, supplementing the classic researches of Strasburger, Hanstein, Hofmeister, and the rest. In the *Ann. des Sciences Nat. Botanique*, 1890, Douliot[7] reviews the later works and, adding some investigations of his own, maintains the positions advanced in 1888 in his paper in conjunction with Van Tieghem. In brief, his conclusions are as follows:

---

[1] Recherches comparatives sur l'origines des membres endogènes, Ann Sci Nat Botan, VII viii I (1888)

[2] Ueber das Scheitelwachsthum des Gymnospermen-Stammes, München, 1882

[3] Ueber die Anlage seitlicher Organe bei den Pflanzen, Leipzig, 1886

[4] Sur l'anatomie et le développement du Ceratophyllum, Bihang, k Sv Vet Acad Hand ix, Stockholm, 1885

[5] Ueber den Vegetationspunkt der Phanerogamen, Ber der deutsch bot Gesell 1885

[6] Zur Frage über das Scheitelwachsthums bei den Phanerogamen, Pringsh. Jahrb wiss Bot. 1884

[7] Sur la croissance terminale de la tige, Ann Sci Nat Botan VII, xi 283

(1). In the twenty genera of gymnosperms which have been studied the uniform presence of a single apical cell at the summit of the growing stem has been demonstrated. This cell, as in the lower vascular Archegoniata, is sometimes pyramidal, sometimes prismatic, but always solitary. Here is the diagnostic anatomical character of the Gymnospermæ. They are, by it alone, sharply discriminated from the rest of the seed-plant phylum.

(2). In the monocotyledons there are two categories to be distinguished; first where there are three initial cells at the apex of the stem from which all the others are derived, as in Phragmites, Tradescantia, Zea, Asparagus, Polygonatum, Canna and others; and second, where there are but two, as in the Naiadaceæ, Potamogetonaceæ, Juncaceæ, Alismaceæ and Hydrocharidaceæ. The latter case is the more frequent.

(3). In the great majority of the dicotyledons the stem is terminated by three apical or initial cells. In a small number, principally in the the apetalous division of the Archichlamydeæ, there are only two initials, and in this case one initial cell is common to the dermatogen and plerome layers of Hanstein, but in the other and more common case each embryonic layer has its own peculiar initial cell. In the Gamopetalæ (Metachlamydeæ) there are three initials, so far as the investigations have gone.

It is thus seen that, in addition to a clearly functional archegonium or egg-organ, the Archispermæ (Gymnospermæ) are distinguished from the Metaspermæ (Angiospermæ) by the presence of a single apical cell. Thus evidence seems to be accumulating in favor of the classification, long ago proposed, which would include the Coniferæ, Cycadeæ and Gnetaceæ with the Pteridophyta, Bryophyta and Characeæ (and possibly the Coleochaeteæ) under the Archegoniatæ—those plants with a functional egg-organ. The Metaspermæ are sharply distinguished by the abortion of the egg-organ while the Thallophyta are as clearly discriminated by the absence or rudimentary condition of the egg-organ. In addition to these characters the Metaspermæ are the only plants which develop their epidermis independently from a definite proto-epidermal meristem cell. This character seems to be an important one from a phylogenetic point of view and gives color to any plan which proposes to recognise the great affinity between the heterosporous Filicneæ and Lycopodineæ, re-

spectively, and the Cycadeæ and Coniferæ. In this connection one can not but deplore that in some quarters American botany has not yet freed itself from the altogether obsolete notion that the Coniferæ should be placed between the monocotyledons and the dicotyledons.—CONWAY MACMILLAN.

Effects of parasitism of Ustilago antherarum Fries.[1]

Ustilago antherarum is included by Saccardo[2] under *U. violacea* (Pers.) Fckl. and is well known as parasitic in the anthers and ovaries of Silene, Lychnis, Saponaria, Pinguicula, Stellaria and other allied plants. By the growth of the fungus, what has been termed by A. Giard "parasitic castration of the anthers" takes place. There is, however, a hypertrophic development of the anther and in the diclinous flowers of Lychnis, which have in common with other such flowers rudiments of the undeveloped sporangia—this hypertrophy suffices to give the flower a monoclinous appearance. Under the irritation of the parasite the rudimentary anthers in pistillate Lychnis flowers are stimulated to develop, but the tapetal and archesporial layers of the thecæ are supplanted by the fungus mycelium and subsequent growth of spores. For a considerable time the Ustilago plant develops by a kind of symbiosis with the cells of the host. This goes so far that the anther walls are, in normally pistillate Lychnis flowers, stimulated to form the typical layers by which the ordinary dehiscence is brought about. Thus the Ustilago spores are scattered from the hypertrophic anthers of Lychnis precisely as if they were normal pollen spores. A corresponding and attendant atrophy of the pistil will be observed in most cases, and it is the nutritive stream which properly should go toward the pistil, that is diverted toward the hypertrophic anthers. And furthermore the various accessory characters of the staminate flower are developed in proper order under this parasitic stimulation, so that the normally pistillate but apparently staminate flower presents the appearance of pollen-bearing to such an extent that it is doubtless visited by those insects which habitually transfer pollen from the staminate flower to the stigma of the pistillate. Now as the Ustilago spores are developed in lieu of pollen spores and make their

[1] Vuillemin: Sur les effets du parasitism de l'Ustilago antherarum, Comptes Rendus Hebd CXIII, 662 (1891)

[2] Sylloge Fungorum VII 574.

appearance in a hypertrophic rudimentary anther which under their stimulation, forms the ordinary dehiscence lines, it happens that when the spores of the Ustilago are ripe, they are distributed by the same means and agencies which commonly distribute the Lychnis pollen. This is of clear advantage to the fungus for it is thus sown upon young buds as well as upon stigmatic areas. The whole series of phenomena is one which indicates in very interesting fashion how intimate and remarkable may be the relation between host and parasite.—CONWAY MACMILLAN.

The behavior of the pollen-tube of gymnosperms.

In a recent paper,[1] preliminary to a more complete research Belajeff publishes some suggestive observations regarding the divisions which take place in the pollen-tube of *Taxus baccata*.

It is well known that one or more cells are commonly cut off from the body of the pollen grain early in its development. Many have considered this cell or cells as representing a male prothallium, and Strasburger states that they have to do with the formation of the pollen tube, and after that have no further part to play. Belajeff, however, was led by his researches into the antheridia of the higher cryptogams and the pollen tubes of the angiosperms to think that it was not the large cell of the pollen grain of gymnosperms, but the small ones which have to do with fertilization. He therefore examined with great care the processes in Taxus baccata with the following result:

In this plant the contents of the pollen grain divides into two cells one large and one small. The larger one, *a*, produces the tube, the nucleus and other contents wandering to the apex. The smaller cell *b*, which remains behind, then divides into two by a partition transverse to the axis of the tube. The anterior of these two, *b*' then wanders toward the apex of the tube while the posterior *b*," becomes disorganized. Its nucleus however also wanders toward the apex, usually passing the anterior cell. The apex of the pollen tube now increases in size considerably as does also the cell *b*'. The nucleus of this now divides into two, one spherical, and the other lenticular. When fertilization occurs the wall of the pollen tube and the very delicate wall of the cell *b*' disappears and the

[1] Berichte der deutschen bot. Gesellschaft IX. 280. (1891.)

spherical nucleus of *b'* fuses with the nucleus of the egg cell of the archegonium.

While it is hardly safe to generalize from such limited observations (for so far they have been confirmed only on Juniperus and that but partially) nevertheless the observations accord much better with what we should expect from analogy with lower and higher plants. If these observations are confirmed by more extended study the pollen tube must be looked upon as the prothallium, while the small cells constitute the antheridium. The one which travels to the apex of the tube must be the mother cell of an antherozoid, to which the spherical nucleus would correspond. Perhaps on account of the imperfect division of *b'* it would have to be considered as more primitive still, being the homologue of the cells from which the antherozoid mother-cells arise.—R.

BRIEFER ARTICLES.

Notes on pollination.—I. The sandy hills, old trees and fences on the north shore of Long Island are covered with *Ampelopsis quinquefolia* Michx. The numerous small, greenish-yellow flowers are quite conspicuous in contrast with their background of green leaves. On the morning of July 22d, there were twenty-two flowers open on one cyme, the pollen-covered stamens outspread, the erect stigma occupying the flower center. Numerous visitors—honey bees, humble-bees, hornets, Sphecidæ, other Hymenoptera small and large, and Diptera—were either sucking the nectar which is exposed in the base of the flower and accessible to the shortest tongues, or collecting or eating the pollen. Almost all of them touched both stamens and stigma before leaving a flower. Early in the afternoon of the same day stamens and petals had fallen from all of these flowers but the visitors continued their visits as industriously as ever—of course, now only sucking nectar.

On the morning of July 23d, no more flowers had opened, and there were none with stamens on this whole plant or on any of the plants near by. The number of visitors was diminished. Early in the afternoon many new flowers had opened on all the plants and insects abounded. July 24th, at 8 A. M., after a heavy rain, very few stamens and petals remained. At 11 A. M. there were many newly opened flowers. July 25th, at 2 P. M., no stamens.

The stigmas appear to remain receptive for some days and the older flowers which contain them alone are visited as often as the freshly opened ones. Self-pollination, which would be easily accomplished, is only possible in the few hours during which the stamens last and even then, owing to the great number of visitors, cross-pollination seems much more probable in pleasant weather.

II. The species of *Trillium* have, so far as I know, been studied with reference to their pollination only by Loew, whose meager notes on imported plants are recorded in Pringsheim's Jahrbücher, vol. XXIII, p. 238.

Four species are grown in the Botanical Garden at South Hadley, Mass., as nearly as possible under natural conditions.

1. The very inconspicuous, dull reddish-brown flowers of *T. sessile* L. are erect "in the bosom of the leaves." The stamens closely surround the stigma. Self-pollination seems inevitable. There is no honey. No visitors were seen though the flowers were watched at intervals each day during their period of flowering. Loew reports one pollen-eating beetle.

2. *Trillium erectum* L. The rather large, brown-red flowers are abundant and rather conspicuous in the Massachusetts woods in early spring. Their strong, disagreeable odor may perhaps attract carrion-loving flies or beetles. Unfortunately I could not watch the flowers in the woods and there were only a few in the garden. Stigmas and anthers stand at nearly the same level, freely exposed in the flower-center by the recurving of sepals and petals. There is no honey and for many days no visitors appeared. Finally four Coleoptera came in one day, apparently to eat the stamens—certainly of little avail in cross-pollination and probably too late to be of use in any case. Spontaneous self-pollination seems to be the rule here too.

3. One morning, some time after the blossoms had all disappeared, a humble-bee flying by me vanished under the leaves of the blood-root bed and continued his buzzing there so contentedly that it was evident treasure had been found. Following him, and pushing aside the large leaves of the blood-root, I found, concealed under these leaves and their own too, the nodding flowers of *Trillium cernuum* L., well hidden from human view but recognized from afar by the keen senses of their lover. He was busily at work sucking nectar which was afterwards seen in small drops at the ovary base, between the ovary and the bases of the filaments opposite the inner perianth leaves. This species is slightly proterandrous, the stamens dehiscing before the petals are outspread and while the stigmas are still close together. After the nodding flower has fully opened self-pollination is easy, the recurving stigmas being just below the pollen-covered anthers.

4. *T. grandiflorum* Salisb. In the first stage, the mouth of the flower is closed by the anthers. Later, the petals expand further, the stamens separate above and the stigmas appear between them, in the flower-center. A little nectar secreted by the "septal glands" lies between the ovary and filaments as in the preceding species. Hive bees occasionally collect the pollen. The stigmas recurving to meet the stamens may be self-pollinated in the absence of visitors.

III. *Oakesia sessilifolia* Wats., *Uvularia perfoliata* L., *Clintonia borealis* Raf., are visited abundantly by humble bees for the nectar contained in the hollowed bases of the perianth-leaves.

IV. While watching the pollination of Asters and Solidagos this fall, I was surprised to find large numbers of humble-bees, honey-bees, wasps, and other large and small Hymenoptera, flies—notably Syrphidæ, beetles and four species of Lepidoptera, visiting *Solidago squarrosa* whose flowers were all withered, to suck the nectar secreted by the involucral bracts. This is another of the cases of the occurrence of the extra floral nectar whose use, if any, to this plant has yet to be discovered.

An article in the *Biologisches Centralblatt* (vol. VIII, p. 577) may shed some light on the use of these extra-floral nectaries. It is in substance this:

Von Wettstein has observed the accumulation of nectar on the involucral scales of *Jurinea mollis*, *Serratula lycopifolia*, *S. centauroides*, *Centaurea alpina*, &c.

In *Jurinea* the secretion begins when the head has attained one-fourth of its full development: it ceases when the first flowers unfold. It begins each day directly after sunrise, increases until about 8 o'clock and then commonly diminishes until evening. Even before sun rise one may find ants sitting motionless upon the buds; as soon as the nectar-secretion begins they seek most eagerly for the places on the scales at which it appears. Of 250 unopened heads, only ten were without ants. The greatest number on one head was twelve, the average three or four. Not seldom they creep over the flowers so that the purpose seems not to be to exclude them from these. Experiment establishes the truth of the theory that the ants, here as in so many other cases, are the protectors of the plants—the pigmies, the body-guard of the giants, as it were.

Fifty buds were protected against ants by winding their stems with wool soaked in camphor-solution and oil. Fifty others were left untouched. After four days all of the heads were examined. Forty-seven of the last lot remained; forty-five of them (90 per cent.) had blossomed normally; beetles had eaten the involucral scales of two;

one had been broken by the wind. Forty-six of the protected heads remained. Twenty-seven (only 54 per cent.) had blossomed normally; seventeen were more or less injured by animals. Ants had gained access to two.

Experiments with *Serratula lycopifolia* Vill., gave similar results, so that the usefulness of the ants in both of these cases can hardly be disputed. But both plants are natives of the tropics where ants are most abundant and most wonderfully developed.

There were few ants upon the involucres of *Solidago squarrosa.* Perhaps this very fact accounts for the large number of beetles. But the beetles as well as the numerous other visitors all seemed to suck the nectar without doing injury to the head, and moreover they were observed after all or very nearly all of the flowers were gone, and their visits continued until the coming of cold weather, that is for about two weeks, if my memory is good.

Ludwig says: "In Jurinea the involucral scales are reflexed during anthesis forming a protection to the flowers, while the scales of Serratula are appressed and accordingly, in Serratula the secretion of nectar continues after blossoming." Solidago differs from both, for its involucral scales are reflexed, and the secretion is of long continuance. The plants were grown under unnatural conditions, on an exposed hill at the edge of the Horticultural Garden here at Ithaca. It will be necessary to observe them in their own haunts another year to ascertain surely whether ants are their guests and the champions against their foes.—ALICE CARTER, *Ithaca, N. Y.*

EDITORIAL.

A NEW FEATURE for American expositions has been inaugurated by the World's Fair commissioners. It is proposed to hold a series of congresses in connection with the Fair, to which those interested in the various departments of knowledge are to be invited. These are to be conducted in the same generous spirit which characterizes the other projects of the exposition. The preliminary circulars have been issued, and some of the special congresses are already quite well organized.

Plans for the Botanical Congress are now under consideration. What these plans shall be depends largely upon the botanists of the country. It is much to be desired that a full and hearty expression of opinion be made public through the botanical and other journals, to

serve as a guide for the committee in charge. As it is necessary to push the arrangements as rapidly as possible, those who have words of suggestion or encouragement to offer should not delay to make them known.

The plan, so far as it has been outlined at present, is to invite the botanists of the world to meet at Chicago, sometime during August, 1893, to discuss such matters of interest as may be arranged for beforehand or be brought up at the time, and to enjoy the benefits of personal acquaintance. During the meeting a few stated lectures will be given by distinguished botanists, designed more especially for the general public. Excursions and other means of promoting good fellowship and a profitable time are among the possibilities.

It is hoped to secure for the gathering a truly international character, which will make it not only a notable and pleasant occasion, but give its deliberations a weight and sanction of authority that will do much toward settling disputed questions and advancing the science.

***

IN THE September number of *Grevillea* the editor makes the most startling comments on the availability of German mycological works. He says, referring to Brefeld's *Untersuchungen aus dem gesammt Gebiete der Mykologie*, "Mycologists are very limited in number in these islands, and some of these are unable to purchase indiscriminately . . . whilst the number capable of perusing German with ease is considerably less. All those capable of reading and appreciating Dr. Brefeld's works for instance, could be counted on the fingers of one hand!" That, if true, is a lamentable condition. But we hope the statement is too strong.

CURRENT LITERATURE.

Minor Notices.

THE ANNUAL report of 1890 of the state botanist of New York,[1] Chas. H. Peck, contains a list of the plants added to the herbarium during the year (261 species); among which are thirty-six new species of fungi. These are described, and figured on the four plates. There is also a revision of the genus *Tricholoma* which is represented in the

[1] PECK, CHARLES H.—Annual report of the state botanist of the state of New York, made to the regents of the University. From the 44th report of the N. Y. state museum of Natural History 8vo. pp. 75. pl. 4. Albany: Lyon, state printer, 1891.

state by forty-eight species. The revision is accompanied by full descriptions of these species, with synoptical tables of each of the different groups. The report closes with a list of the plates in a MS. volume regarding the fleshy fungi of Maryland prepared in the course of several years by Miss Mary E. Banning of Baltimore. Miss Banning has made water-color drawings (175 sheets 12×15 inches) of 151 species, accompanied by MS. descriptions and notes, together with a full index. This volume she has presented to the State Museum — a most generous and valuable gift.

VERY FEW researches on the bacteria of the deep sea have been made; indeed the studies of Mr. H. L. Russell, a graduate and sometime Fellow of the University of Wisconsin, which he prosecuted at the zoölogical station at Naples, are almost the first. Through the kindness of the director, Dr. Dohrn, every convenience was afforded him for obtaining samples of water and slime at every available depth in the Gulf of Naples and for investigating the forms so obtained. A large number of soundings were made, up to 1100 meters (3600 ft.). While the observations were not sufficiently numerous to constitute a complete investigation of the subject, the conclusions reached are interesting. Mr. Russell found that the number of micro-organisms present in the sea water appeared rather smaller than those in an equal volume of fresh water. (Upon the latter the author made prolonged study while at the University of Wisconsin.) There do not appear to be any zones of distribution of the bacteria in the water, but the superficial and deepest parts have about the same number. In the slime the number is always vastly greater than in the water above; and their proportion, except perhaps in the littoral zone, is not due to contributions from land but from the growth and multiplication of endemic individuals. Although there are no zones of distribution in the water, in the slime there is a gradual diminution from the maximum near the surface to a depth of 200 m., but from that depth on to 1100 m. (the greatest depth investigated) there is no diminution. The minimum was therefore not reached.

Mr. Russell has brought back with him a large number of cultures of the forms obtained from the deep sea which he intends investigating qualitatively.

DR. C. E. BESSEY publishes as a bulletin of the agricultural experiment station, a list of the native trees and shrubs of Nebraska. The

[1]RUSSELL, H. L.—Untersuchungen über in Golf von Neapel lebende Bacterien. Separat-Abdruck aus der Zeitschrift für Hygeine und Infectionskrankheiten, Band XI. 1891. 8vo. pp. 165—207. pl. XII. and XIII. 1891.

list includes 125 species, about equally divided between the two. A discussion of the distribution of the woody plants of the state at the close is interesting. Dr. Bessey thinks that this distribution shows that the woody plants have nearly all come up the Missouri bottoms and spread west and north-west. Those found only in the western part have undoubtedly come from the Rocky Mountains and have spread eastward to their present limits.

The nomenclature of the list shows a wide departure from that of the Manuals. Justifiable as many of these departures are, they seem out of place in such a publication as the present, because they certainly interfere with its usefulness for those not specialists.[1]

IF COLLECTORS are not properly informed as to how to collect plants it will not be for want of instructions. Two months ago we noticed Prof. Penhallow's booklet; now we have before us a pamphlet issued by the National Museum and prepared by Mr. F. H. Knowlton.[2] It contains directions for collecting all sorts of plants, as well as for caring for them after they are collected. In its preparation the author has drawn freely on Bailey's Collector's Handbook and the herbarium number of this journal (June, 1886, for which there was such a demand that the extra edition was soon exhausted). In many respects the present directions are better than their predecessors; it extends their range by giving directions for the collection of fossil plants. Certainly now if one puts together the instructions to be found in every text book and in almost every flora, those of Bailey, Penhallow and Knowlton, he will have all the knowledge that writing can give him of how to preserve plants. *Jam satis!*

OPEN LETTERS.

A section of botany in the American Association.

The thought of having a section for the botanists in the A. A. A. S. should be very inspiring to all who have at heart the thorough study of plant life in America. All admit that Section F is now crowded with members and papers, and doubtless many are deterred from taking part in the sessions from lack of opportunity. At the last

---

[1]BESSEY, C. E.—Preliminary report on the native trees and shrubs of Nebraska. Bulletin 18 of the Ag. Exp. Sta. of Neb., vol. iv. art. iv. pp. 171–202.

[2]KNOWLTON, F. H.—Directions for collecting recent and fossil plants. Part B of Bulletin of U. S. Nat. Mus. no. 39. 8vo. pp. 46. figs. 10. Washington: Gov. Printing Office. 1891.

meeting numerous papers were passed without comment or discussion that the programme might be carried out.

The work of the section has naturally divided itself into two groups, namely, that pertaining to animal life, and to botany. In order to gain more time and draw together more closely those who are interested in particular branches, clubs have been formed. Thus the entomogical and botanical clubs have arisen and grown into features of the week of as much importance as the section and more perhaps to the younger members. These clubs should, and doubtless will be continued. In the section itself for years there has been an attempt on the part of the programme committee to group the subjects so that zoölogists and entomologists have had a half day assigned them, alternately with the botanists. This has virtually broken up the continuous attendance of members upon the sectional meetings and excursions or other events are indulged in by the party not upon the programme. Perhaps to our shame, this has been particularly true of the botanists who have sometimes left the zoölogists with a depleted but more homogeneous and attentive audience. Also within the past few years the plan of having time assigned for a series of connected papers upon one or more of the branches of science coming under the present scope of the section has still further differentiated the work. As Section F now stands its sessions are largely an alternation of groups of subjects with an audience that shifts with the programme.

A notice of an amendment to divide Section F is therefore well founded; the division is very natural and one that, in fact, has already been made, so far as arranging the programme by grouping the subjects and by the work of the clubs will permit it. In short, it has gone as far as it can save by a division of the section itself.

The contemplated division will bring many gains without corresponding losses. Time will then be offered for thorough sectional work upon the two large and growing fields of biological science, instead of the rapid reading of papers as at present, followed by little or no discussion before a half interested audience.

With a Section of Botany, for example, officers can be selected who will be interested in all subjects presented, a condition that does not always obtain under the present arrangement, to say nothing about the difficulty that may now arise as to the proper apportionment of the official plums among the aspirants for honors.

If we believe in the principle of division of labor and specialization, in short in the theory of evolution in its broad and best sense, we cannot but feel that the proposed step is in the direction of advance, and realize that the last few meetings of Section F indicate clearly that the time to take the step forward is at hand.

The best way to make the importance of a division still more emphatic is for every student of the biological sciences to come, if possible to the Rochester meeting with a large number of full papers, and strive to have as many as possible read and discussed in Section F, the balance of shorter ones to be considered as best they may at the clubs. As a section of Botany is asked for, let the botanists in particular show by their works, their faith in the reasonableness of the demand.—BYRON D. HALSTED, *Rutgers College*

The Baltimore oriole mutilating flowers.

The interesting note of J. Schneck in regard to the oriole piercing the flowers of the trumpet-vine for the nectar reminds me of a note which I sent the *American Naturalist*, and printed in 1869, on p. 380. In that case the Missouri currant (*Ribes aureum*) was the plant. The fact of their piercing large numbers of flowers for at least two seasons in the village of Union Springs, Cayuga county, was well established. Honey bees gleaned freely of the honey through these holes, as the corolla is too long for them to reach it through the tube.— W. J. BEAL, *Agricultural College, Michigan.*

Misconceptions of botanical homologies.

I had occasion in the June number of the GAZETTE, last year, to call attention, on pp. 178, 179, to the vicious confusion in the terminology of the spermaphytic flower. Two melancholy examples of this confusion have just come to my notice and I cannot forbear referring to them. One is on pp. 162, 163 of Warming's *Haandbog i den systematiske Botanik* (German translation), where under the bold headline *Die ungeschlechtliche Generation der Kormophyten* occurs considerable talk about "eingeschlechtig," "zweigeschlechtig" and "hermaphrodite" flowers, thus affording an exquisite illustration of how easy it is to classify black, blue and green under the generic head of pale yellow.

The other example is sadder, for it is the cause of a serious blunder. It is in Geddes and Thompson's "Significance of Sex," a very suggestive and admirable work, after reading which one can not but regret that it apparently did not occur to the authors to give particular attention to botany as one of the biological sciences. But this is an ordinary oversight. On p. 48, where the discussion of nutrition as influencing sex is going on, we have a couple of tolerable pictures of the diclinous, asexual, pollenar and ovular plants of *Lychnis diurna* figuring as the "male and female flowers;" and, basing their remarks upon such a failure to comprehend plant homologies, the authors observe that "the botanical evidence, though by no means very strong, certainly corroborates the general result that good nourishment produces a preponderance of females." It is just here that Geddes and Thompson, misled by the false terminology which botanists, to their discredit, still suffer to continue, lose the opportunity of making a strong point along their line of research.

Let us see what the condition really is in plants of the type of *Lychnis*. The pollen grain or microspore produces a one or two-celled male plant — the pollen-tube: the megaspore or embryo-sac produces a seven-celled female plant. What was the origin of the two sizes of spores? In short this: spore-mother-cells in certain sporangia divided internally into four spore-cells, each of which developed to maturity and was a pollen-spore. In other sporangia the spore-mother-cell formed four nuclei and the potentially *four*-spored contents produced only *one* spore — the embryo-sac — *because one of the cell-nuclei reabsorbed the others, and one cell united to itself the three sister cells.* Where could there be found a more instructive example of high spore-nutrition tending to develop a female plant? It is superb. One might challenge the zoölogist to bring forward any evidence

clearer than this. In fact it is in the plant world that we must look for much of our testimony along the more difficult lines of biological science. And it is the duty of botanists to clear up the confusion of their terminology, especially along those lines which are subject to so great popular misapprehension. It should not be possible, even for the casual reader of botany, to encounter such contradiction and error as clusters about the spermaphytic plants, imbedded in a misleading terminology.— CONWAY MACMILLAN, *University of Minnesota, Minneapolis.*

NOTES AND NEWS.

THE VENERABLE curator of the botanical museum at Berlin, Friedrich Karl Dietrich, is dead at the age of 85.

DURING THE year 1890 42,646 specimens were added to the Herbarium of the British Museum, according to the report just published.

MR. A. S. HITCHCOCK, of the Missouri Botanical Garden, has been appointed Professor of Botany in the Agricultural College of Kansas at Manhattan.

MR. P. H. ROLFS, recently connected with the Iowa Agricultural College, at Ames, has been appointed botanist and entomologist of the Florida Agricultural Experiment Station at Lake City, Fla.

MR. WILLIAM WEST has a paper in the December number of the *Journal of Botany* on the freshwater Algae of Maine, in which three new species and several new varieties are described. There are also notes on other species of the collection.

DR. FR. ORTLOFF of Coburg (Thuringia) Germany, has just issued a series of photographic reproductions of the stem-leaves of Sphagnum which are of so much diagnostic importance in the discrimination of the polymorphic species of this genus. The series contains 63 plates.

PROF. L. H. BAILEY has been appointed special agent of the United States Weather Bureau to make a report upon phenology, and desires reference to all records upon the relation of climate to the times of blooming, fruiting, leafing, etc., of plants. He may be addressed at Ithaca, N. Y.

PROF. R. E. CALL has given an account of the silicified woods of E. Arkansas in the *American Journal of Science* (Nov. 1891), in which he concludes that they are all Tertiary (Eocene), are silicified lignite, and are as yet of no taxonomic value in determining relative ages in the Tertiary series.

THE MOSS herbarium of the late Dr. S. O. Lindberg has been acquired by the University of Helsingfors. Exclusive of duplicates and of numerous exsiccati the collection contains 5,046 species represented

by 47,858 specimens. It is especially rich in northern Hepaticæ, and is remarkable for the completeness, abundance and critical elaboration of the material.

PROF. W. W. BAILEY writes: "One of my students called my attention the other day to a *Linaria* raceme in which the flowers were all spurless. Peloria is not infrequent this autumn." And again: "As my colleague, Mr. Bennett, was drying some capsules of *Ceanothus* in the sun. for the purpose of securing the seeds, he noticed, and showed me, that these parts exploded with much violence, ejecting the seeds."

A FOUR PAGE supplement to the "Analytic Keys to the genera and species of North American mosses" has been prepared and issued as separates from the 8th volume of the Transactions of the Wisconsin Academy. It contains additions and corrections and may be obtained of the author (C. R. Barnes, 712 Langdon St., Madison, Wis.) *gratis*, by sending a request accompanied by a 2-cent stamp. It will be of no value except to those who have a copy of the Keys.

THE SERIES of *Hepaticæ Americanæ exsiccatæ* has been issued by L. M. Underwood and O. F. Cook, in sets of two decades annually since 1887. Many rare and previously undistributed species have been sent out, and others are to follow, including specimens from British Columbia, Florida, Cuba and Mexico. Decades XI and XII are now ready for distribution. Preceding issues are all exhausted with the exception of decades IX and X, of which a few sets are still on hand. Correspondents should now address Dr. Underwood at Greencastle, Ind.

IN VIEW OF a contemplated special investigation of the genus Astragalus (including Phaca, Diplotheca, Homalobus, and Podolotus), Mr. E. P. Sheldon, Assistant in Botany at the University of Minnesota in Minneapolis, desires specimens of this genus from all parts of the world. In exchange he offers either fungi or flowering plants from the valley of the Minnesota river, which derives a peculiar interest from its position as the central drainage system of the continent of North America. Plants may be sent to him in care of the university, and will be promptly acknowledged.

THE HERBARIUM of Indiana University was established upon the election last April, of Professor John M. Coulter, as President. In addition to private material already in the possession of Professor Coulter, a liberal appropriation for the purchase of plants was made. All the well-known collectors of phanerogams and pteridophytes were asked to furnish as complete sets of their collections as possible, and these purchases now amount to over 15.000 species of North American plants. A very valuable library of reference books has also been secured. It is expected that the collection of books and plants will increase as rapidly as material for purchase or exchange becomes accessible. Mr. Henry E. Seaton has been appointed curator.

A NEW JOURNAL of forestry, *Forstlich-naturwissenchaftliche Zeitschrift*, is to be begun with the year. It is to be the organ for the Munich laboratories of forest botany, zoology, chemistry and meteorology, under the editorial management of Privat-docent Dr. Carl von Tubeuf of the University of Munich. Of course it has the support

and contributions of Dr. R. Hartig who is to continue in this journal the "Untersuchungen aus dem forstbotanischen Institut" he ceased to publish in 1883. Drs. Ebermayer, Pauly and Baumann of Munich are to aid, and the journal has the promise of coöperation from many others who are learned in forestry. Among these we notice but one from this country, Mr. B. E. Fernow, chief of the division of forestry of the Agricultural Department.

DR. PAUL KNUTH seeks to explain why many flowers, without apparently very attractive coloration are so readily found by insects. *Sicyos angulata*, for example, was surrounded by swarms of insects, while at the same time other plants in the botanic garden at Kiel were neglected. The ethereal oil secreted by the glands of the flowers, stem and leaves, which affect the senses of man so slightly, may be partly the cause of the attractiveness of this plant to its insect visitors. But he finds also that the greenish white flowers are probably much more striking to insect eyes than to our own, on account of the ultra-violet rays which lie beyond the range of our vision. That such rays are reflected by these flowers he showed by their effectiveness upon photographic plates with short exposures. They are photographically as active as white flowers, while the intensity of light reflected (photometric activity) is only one-third that of white flowers. We have here apparently an analogy with those sounds which can be heard by insects, but which are beyond the range of the human ear.

MR. JOHN B. LEIBERG writes from northern Idaho: "My list of mosses from this region now foots up 304 species and varieties. Many of these are as yet undetermined. Some have only turned up as fragments amongst other mosses. . . . The magnitude of western bryology is utterly unappreciated by bryologists of this country unless they have been here in person and seen it with their own eyes. Most of my observations have been limited to the western slope of the Bitterroot mountains. There are 250 miles of this range extending north and south, and the width of the western slope varies from 30 to 120 miles. There are millions of canyons and ravines in this tract of country. Of all the thousands I have seen into I never saw two where exactly the same climatic conditions prevailed. It is a fact easily proved that changes on climatic conditions mean changes in both the vegetative and structural aspect of mosses more quickly than in any other group of plants. . . . It is an impossibility for collectors to obtain all the various aspects of any species for generations to come, so our knowledge of the western mosses will come slowly and painfully, for collecting mosses among these mountains is no holiday excursion."

DR. FR. KRASSER recommends the following methods for preparation of permanent mounts of aleurone grains to show the ground substance, crystalloid and globoid differentially stained.

I. Picro-eosin method. Fix the section with picric acid dissolved in absolute alcohol; remove the excess by washing with absolute or a high grade alcohol; stain with eosin dissolved in absolute alcohol; partially decolorize with absolute alcohol; clear with clove oil; mount in Canada balsam dissolved in chloroform. The course of the stain-

ing, which is completed in a few minutes, should be watched under the microscope, as should also the toning down. The most successful preparations show the ground-substance dark red, the crystalloid yellow with sharp contours, and the globoid nearly colorless to reddish.

II. Picro-nigrosin method. Place the section in alcoholic-picro-nigrosin (a saturated solution of picric acid in absolute alcohol+nigrosin approximately to saturation) in which it is allowed to remain until the ground-substance of the aleurone grain shows a blue coloration. This is to be determined by observations at intervals with the microscope, the specimens being put into absolute alcohol temporarily. Wash with absolute alcohol; clear on the slide with clove oil; mount in Canada balsam, removing the clove oil with filter paper. The most successful preparations show the ground substance blue, the globoid colorless, and the crystalloid yellowish green and sharply limited.

THE difficulty of keeping Irish potatoes in edible condition in late spring is well known to housekeepers, farmers, and merchants. Professor Schribaux of the National College of Agriculture of France has recently devised a very simple, cheap, and successful method by which he has been able to preserve potatoes in edible condition for over a year and a half. This process has been adopted by the French government for preserving potatoes for the army. The French Minister of Agriculture publishes the details of the process in the official *Bulletin du Ministère de l'Agriculture* for March, 1891. The following is a translation of the essential part of the scheme. The method of preservation consists in plunging the tubers, before storing them away, for ten hours into a two per cent. solution of commercial sulphuric acid in water, two parts of acid to 100 parts of water. The acid penetrates the eyes to the depth of about one-fortieth of an inch, which serves to destroy their sprouting power; it does not have any appreciable effect upon the skin of the potatoes. After remaining in the liquid ten hours the tubers must be thoroughly dried before storing away. The same liquid may be used any number of times with equally good results. A barrel or tank of any kind will do for the treatment. The acid is so dilute it does not affect the wood. Chemical analysis shows that potatoes treated by this process are as nutritious and healthful after eighteen months as when freshly dug; but they are of course worthless for planting. Attention is called to this method by Gerald McCarthy, N. C. Experiment Station, Raleigh.—*Science*, Nov. 13.

IN THE *Revue Bryologique* (n. 6, 1891) appears a synoptic table of the species of the genus *Fontinalis* recognized by M. Jules Cardot in his recent revision of the family Fontinaleæ. which he hopes to publish early this year. The North American species are as follows according to M. Cardot:

§ I. **Tropidophyllæ.**

F. antipyretica L. (N. Am.)
 var. gigantea Sull. (N. Am.)
 var. Californica Lesq.—(Calif.)
 var. Oregonensis R. & C.—(Oregon.)
 var. rigens R. & C.—(Vancouver: Wash.)
 var. ambigua Card.—(Oregon.)

*F. Kindbergii R. & C.—(Vancouver: Oregon: Idaho.)
*F. Neo-Mexicana S. & L.—(Rocky Mts.: N. M.: Idaho: Calif.: *Wash.: Vancouver.)
*F. Columbica Card.—(Br. Columbia.)
F. chrysophylla Card.—(Utah.)

§ II. **Heterophyllæ.**

F. Howellii R. & C.—(Oregon.)
F. biformis Sull.—(Ohio: Wisc.)
F. disticha Hook. & Wils.—(La., Ala.)
F. Renauldi Card. = *F. Sullivantii* Aust. non Lindb.; *F. Lescurii*, var. *ramosior* Sull.?—(New Jersey.)

§ III. **Lepidophyllæ.**

[F. squamosa L.]
*F. Delamarei R. & C.—(Miquelon.)
*F. Dalecarlica B. & S.—(Canada: Eastern States.)
F. Novæ-Angliæ Sull.—(Eastern States.)
*F. Cardoti Ren.—(Virginia.)
F. involuta R. & C. = *F. squamosa* Drumm. Musci-Am. II.n.152.—(La.)

§ IV. **Malacophyllæ.**

F. hypnoides Hartm.—(N. Am.)
*F. nitida Lindb. & Arn.—(Br. Columbia.)
*F. tenella Card.—Idaho.)
F. Durıæi Sch.—(California.)
F. Lescurii Sull.—(excl. var.)—(Canada, U. S.)
F. flaccida R. & C.—(La.)
F. Sullivantii Lindb. = *F. Lescurii*, var. *gracilescens* Sull.—(U. S.)

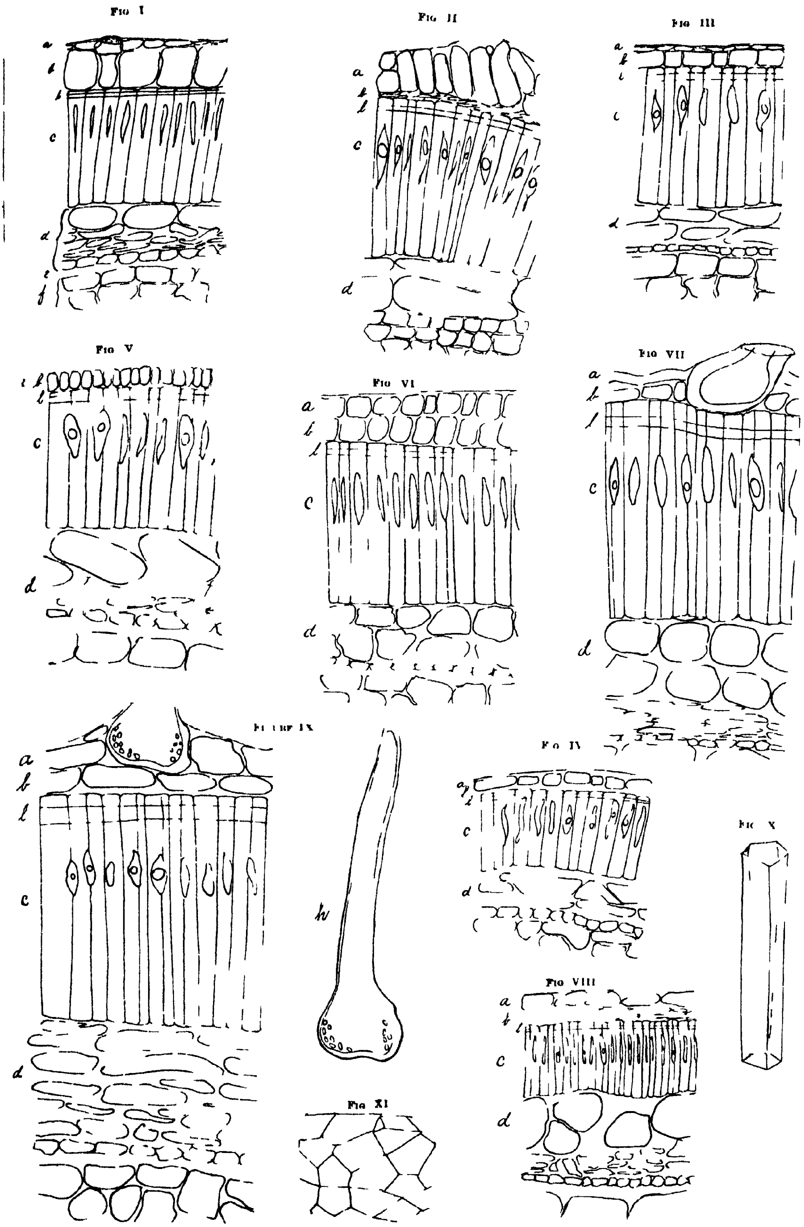
§ V. **Stenophyllæ.**

F. dichelymoides Lindb.—(Minn.)

§ VI. **Solenophyllæ.**

F. filiformis S. & L.—(Ky.)
F. Langloisii Card.—(La.)
F. maritima Müll. and *F. mollis* Müll. (Washington) are both unknown to M. Cardot. North America has 24 species and subspecies out of the 52 known.

*Subspecies.



ROLFS on SEED COATS

BOTANICAL GAZETTE

FEBRUARY, 1892.

The seed coats of Malvaceæ.*

P. H. ROLFS.

(WITH PLATE III)

Much attention has been given to the rich field of development and structure of seed coats. Most of the work has been done by European investigators. American botanists are rapidly taking up the work, and are studying not only the seed coats but the entire anatomical plant structure.

Of the investigators who have given the matter of seed coats attention, Gaertner,[1] Bischoff,[2] Schleiden and Vogel,[3] Harz,[4] Nobbe,[5] Sempolowski[6] and Lohde[7] may be mentioned. H. Godfrin,[8] who has examined the seed coats of thirty-four orders, finds that while the structure of the seed coats is useful in some directions, it is of no taxonomic value.[9] Bachmann,[10] in his paper on the development and structure of seed coats of Scrophulariaceæ, says that the microscopic characters of seed coats are of little value from a systematic standpoint.

In the order of presenting the different genera and species of this paper Gray's Manual has been followed. In all twenty-two genera and thirty-four species were studied. The gen-

*A thesis in Department of Botany, Iowa Agricultural College

[1] GAERTNER De Fructibus et Seminibus Plantarum, 1791

[2] BISCHOFF Handbuch der bot Terminologie und Systemkunde, 1883

[3] SCHLEIDEN and VOGEL Ueber das Albumen insbesondere der Leguminoseen.

[4] HARZ: Landwirthschaftliche Samenkunde, Berlin, 1885

[5] NOBBE · Handbuch der Samenkunde, Berlin, 1876

[6] SEMPOLOWSKI Ueber den Bau der Schalen landwirthschaftlich wichtiger Samen, 1874

[7] LOHDE · Ueber die Entwickelungsgeschichte und der Bau einiger Samenschalen Inaugural dissertation, Naumburg, 1874 p. 34

[8] GODFRIN: Étude histologique sur les téguments seminaux des angiospermes. Nancy, 1880. pp 112, 5 plates

[9] L H PAMMEL: On seed coats of the genus Euphorbia Proc Am. Assoc. Adv. Sc vol XXXIX, 1890 p 328

[10] BACHMANN. Die Entwickelungsgeschichte und der Bau der Samenschalen der Scrophularineen Halle, 1880 pp 179, 4 plates

eral structure of this order is very characteristic. There are minor differences only in the different species of the same genus and non-essential variations in the different genera.

The seeds of Malvaceæ are anatropous. The seed coat is made up of two integuments. The ovule is made up largely of parenchymatous tissue which in the early stages contains a great deal of starch. Upon the thickening of the endosperm cells this starch disappears.

A cross section of a recently fertilized ovule of *Malope trifida* Cav. discloses that but a slight differentiation in the two integuments has taken place; they are made up of prismatic cells, which in the outer layer are rectangular, while in the inner they are more nearly isodiametric. The difference is not alone in form; the outer integument is distinctly clearer than the inner, which is rich in protoplasm. This indicates that we are to have a more marked change in the inner than in the outer integument. In the course of development the cells of the outer integument change but slightly, simply increasing in size. The small starch grains contained in it disappear with the thickening of the walls of the cell. From the great radial growth of the first layer of cells in the inner integument and the thickening of the outer layer in the outer integument, the second layer of the outer integument is compressed until the upper and lower cell-walls are nearly or quite contiguous.

More decided changes take place in the inner integument. The second cell layer takes on a rounded form while the third layer of cells has been divided parallel to the endosperm. The second layer of cells increases rapidly in size compressing the fourth layer. During this time the first layer has lengthened out radially until the length of a cell is nearly three times its width. This layer is known as the palisade layer, which is so characteristic in this order. The palisade cells contain starch in the early stages. During the thickening of the walls the amount of starch diminishes. When the cell-walls have reached their thickness the starch has disappeared.

In a mature palisade cell, a cell cavity may be seen about one-third the distance from the outer end. These cavities often contain a spherical mass resembling a nucleus, which dissolves readily on the application of Schulze's medium. Between the cell cavity and the outer end of the palisade cell appears the light line which is present in a number of orders.

It appears as a continuous pellucid band (fig. 1 *l.*) across the outer end of the palisade cells. In the Leguminosæ this was noticed, at least as early as 1838, by Schleiden and Vogel.[11] The nature of this light line has been studied by a number of investigators. Quite different views have been taken in regard to it.[12]

Russow,[13] after investigation, comes to the conclusion that the cell-wall is more compact and contains less water at this place. Sempolowski[14] is of the opinion that it may be due to a differentiation in the molecular structure of the cell-walls. Lohde,[15] who studied carefully the development and structure of the seed coats of some Convolvulaceæ and Malvaceæ thinks that it arises from the cuticularization of small particles of the palisade cells. Junowicz,[16] after an exhaustive study, finds that the light line is present only in palisade cells; that the cell-wall at this place refracts light strongly, and that the refraction not due to a chemical change in the cell-wall, i. e., cuticularization. Beck[17] says that it cannot be due to a cuticularization, nor is there a difference in the amount of water contained in that part of the cell-wall, although there are certain chemical and physical differences.

Immediately under the palisade cells are two layers of roundish cells of dark brown colôr. The number of integuments in the different species studied is the same, and the number of layers of cells in each integument is practically the same.

ALTHÆA ROSEA Cav.; fig. I.—In specimens of A. rosea the outer integument, *a b*, has both layers of cells developed, the outer layer, *a*, being developed rectangularly in a tangential direction. This layer gives rise to the epidermal outgrowths, or seed hair. The next layer, *b*, is nearly isodiametric.

---

[11] VOGEL. l c Vol XIX pars II, taf XLIII, fig. 55, 58; taf. XLV, fig. 77, 80. Nova Acta der Leop Car. Academie

[12] O. MATTIROLLA: La linea lucida nelle cellule Malphigiani degli integumenti seminali Mem della R. Acc delle Sc di Torino Ser II, Vol. XXXVII. See abst. Just's Bot. Jahresb., 1885. p. 825.

[13] RUSSOW. Vergleichende Untersuchungen über die Leitbundel-Kryptogamen, pp 32 St Petersburg, 1872

[14] SEMPOLOWSKI. Beitræge zur Kenntniss des Baues der Samenschalen, p. 11, Leipzig, 1874

[15] LOHDE: l. c, p 30, 36

[16] JUNOWICZ: Die Lichtlinie in den Prismenzellen der Samenschalen, p. 3, p. 18; p. 17. Prag, July 12, 1877

[17] GUNTHER BECK: Vergleichende Anatomie der Samen von Vicia und Ervum, pp. 32 Sitzb. d. k. Akad d Wissensch Band LXXVII. I. Abth. Mai Heft. 1878.

There is no deposition of intercellular matter in this integument nor between the two integuments. The palisade cell, *c*, is of moderate size. The cell cavity is nearer the upper end than ordinary. Nodosity is not often present. The light line, *l*, is not so sharp or distinct as in many species. The sub-palisade portion, *d*, is made up of a layer of large cells and several small ones. The small cells are narrow. The whole is of a chestnut brown color. The endospermal covering, *e*, is rather delicate. The first layer of cells in the endosperm, *f*, is made up of regular cells.

Measurements: seedcoats, 104μ; outer integuments, 29μ; outer layer of same, 11μ; inner layer of same, 18μ; palisade layer, 52μ; sub-palisade, 23μ.

MALVA SYLVESTRIS L.; fig. II.—The surface of M. sylvestris is rough in appearance. The second layer, *b*, of the outer integument, *a*, has been compressed into a thin layer and seems to have no definite arrangement. The outer layer, *a*, has been elongated radially. In places these elongated cells have divided forming a double layer of cells. There is no brown coloring matter in this integument nor is there any between the integuments. The palisade cells, *c*, are clear; the walls thick. The cell-cavity occupies about one-third the length of the cells, the lower end reaching to the middle. The nodosity is prominent. Below the cavity the cells are clear, almost transparent. The sub-palisade portion, *d*, is usually made up of two layers, at some places only one, of large dark brown cells.

Measurements: seed coats, 122μ; outer integument, 27μ; outer layer of same, 22μ; inner layer of same, 5μ; palisade layer, 70μ; sub-palisade, 25μ.

CALLIRRHOE TRIANGULATA Gray; fig. III.—The inner layer, *b*, of the outer integument is developed into isodiametric cells. The outer layer, *a*, is drawn out tangentially until linear. The cells are colorless and are closely contiguous to the palisade layer. The palisade layer, *c*, is clear throughout, with the borders of the cells sharply defined. Cell-cavity is large and near the upper end of the cells; nodosities prominent. The light line, *l*, is wide and sharply defined. The sub-palisade portion, *d*, is composed of two layers of cells, the cells of the upper layer having very thick brownish walls.

Measurements: thickness of seed coats, 90μ; outer integument, 9μ; inner layer of same, 6μ; outer layer of same, 3μ; palisade layer, 63μ; sub-palisade layer, 18μ; length of sub-palisade layer, 28μ.

CALLIRRHOE INVOLUCRATA Gray; fig. IV.—The outer layer, *a*, of the first integument is developed into large cells. This is just the reverse of C. triangulata. The cells are variable; some are isodiametric; they elongate gradually until some are almost linear tangentially. This layer is colorless. The inner portion of the palisade-cells, *c*, is almost transparent. The cell-cavity is very large and situated nearer the middle of the cell than in most cases. The light line is not sharp and quite near the outer end of the cell. The sub-palisade portion, *d*, is composed of two layers of large cells, the larger being nearer the palisade cells.

Measurements: seed coats, 62μ; outer integument, 8μ; outer layer of same, 6μ; inner layer of same, 2μ; palisade layer, 39μ; sub-palisade, 15μ.

MALVASTRUM ANGUSTUM Gray; fig. V.—The second layer, *b*, of the outer integument is developed into radially elongated cells. These cells are about twice as long as wide. The outer layer contains no coloring matter. The cell-walls between the first and second integument contain a small amount of yellowish coloring matter. On each side of the outer integument is a narrow band, *i*, that refracts light strongly. The palisade cells, *c*, are quite remarkable in having the clearest portion occurring outside of the cavity. This may account for the apparent dimness of the light line, *l*. The position of the light line is normal. The cell cavity is large and the nodosity prominent. The sub-palisade portion, *d*, contains one layer of very large dark brown cells. The large cells take a diagonal position. In some specimens they look like an ∽. This is not quite so striking in *M. coccineum* Gray.

Measurements: seed coats, 104μ; outer integument, 9μ; second layer of same, 8μ; palisade layer, 65μ; sub-palisade, 30μ.

SIDA NAPÆA Cav.; fig. VI.—The outer integument, *a*, *b*, is composed of two layers of cells about equally developed. The shape in both layers is quite variable, from elongated radially to elongated tangentially. The cell-walls are colored yellowish brown.

The outer portion of the palisade cells, *c*, especially around the cell cavity, is more or less yellowish. The light line, *l*,

is not very prominent and quite near the end of the cells. The lower portion of the cells is colorless, almost transparent. The sub-palisade portion, *d*, is composed of two layers of cells. These cells are large, brown and elongated tangentially.

Measurements: seed coats, 120μ; outer integument, 24μ; palisade layer, 70μ; sub-palisade layer, 26μ.

ABUTILON AVICENNAE Gaertn.; fig. VII.—The outer layer, *a*, of the first integument is transformed into a strongly refractive layer. Thes econd layer is composed of radially elongated cells. The seed hairs arise from a single cell and are large and conspicuous. The hairs are spindle-shaped and thin walled; they occur mostly at the ends of the seed and are more or less pressed to it. There is little or no coloring matter in this integument excepting in the base of the hair cells. The palisade cells, *c*, are narrow for their length. The cell cavity is not prominent and the nodosity is inconspicuous. The light line is narrow and occurs near the outer end of the palisade layer. The sub-palisade portion, *d*, is made up of two layers of light brown cells. They are symmetrical and elongated tangentially.

Measurements: seed coats, 147μ; outer integument, 13μ; palisade layer, 96μ; sub-palisade, 38μ.

MODIOLA MULTIFIDA Moench.; fig. VIII.—The first layer, *a*, of the first integument is developed into tangentially elongated cells. The second layer, *b*, has been compressed into an irregular shape. This layer contains much yellowish coloring matter. The palisade layer, *c*, is clear, almost transparent, the cell cavity long and the nodosity not conspicuous. Both the cell cavity and the nodosity lack the yellow color usually present. The light line, *l*, is indistinct. The sub-palisade portion, *d*, seems to be made up of two layers of cells. The cells of the different layers alternate. The outer layer is composed of very large spherical cells. The second layer is also made up of spherical cells but not so large as the outer; both are of dark chestnut brown color. Below this is a thick portion of irregularly shaped cells of brown color.

Measurements: seed coats, 84μ; outer integument, 14μ; palisade layer, 32μ; width of same, 4μ; sub-palisade, 38μ; diameter of upper layer, 26μ; diameter of lower layer, 14μ.

. HIBISCUS MILITARIS Cav.; figs. IX, X, XI.—The first layer, *a*, of the outer integument is most prominently developed. This layer gives rise to the seed hairs. These hairs, *h*, are spindle-shaped, with the walls thin and fragile. The walls of the basal cell are stronger than the neighboring cells. The seed hairs are made up of single cells each containing a small amount of granular matter at the base. The color of the integument is chestnut brown. Cells in the second layer, *b*, are elongated tangentially. The palisade layer, *c*, is composed of large cells, wide in comparison with their length. The cell-cavity is comparatively small, the nodosity prominent. The light line, *l*, is strong and large. Under ordinary magnification ($\frac{1}{6}$ objective) it appears as an unbroken band across the outer end of the cells. Using a strong magnification ($\frac{1}{10}$ or $\frac{1}{16}$ oil immersion) each cell-wall interrupts the line. The portion of the light line in each cell is divided or nearly divided into two or three bodies. Under an analyzer the light line takes on blue a little earlier than the adjoining field. When the field is most intense blue the light line is dark on the inner border and dark blue on the outer. Just before the section comes into focus the light line appears dark taking on the characteristic colors when in focus, while the color of the adjoining field does not depend upon the focus. A thick section shows the following colors under the analyzer, blue, green, yellow, pink. The colors appear only above the cell-cavity. The portion below the cell-cavity gives only blue and yellow distinctly. The cell-cavity agrees with the upper portion of the cells. The nodosity does not change polarized light. The other cells of the seed-coat give no decided reaction under the analyzer. After isolation a cell parts easily immediately below the cavity and sections often behave in a similar manner. The cells, fig. X, are usually pentagonal and somewhat elongated in the direction of least circumference. (Fig. XI.)

The sub-palisade portion, *d*, is composed of three prominent layers and a number of less regular closely massed cells. This layer has a great amount of dark coloring matter, which is a dark chestnut brown.

Measurements: seed coats, 187μ; outer integument, 26μ; outer layer of same, 17μ; inner layer of same, 8μ; palisade layer, 103μ; sub-palisade layer, 58μ.

Lake City, Fla.

Evolution in methods of pollination.

ALICE CARTER.

•In attempting to arrange our phanerogams in a natural order, I have been astonished at the close resemblance even in external appearance between the reproductive organs of Coniferæ and Pteridophyta; at the Equisetum-like arrangement of the spore cases (anthers and ovules) in many of our exogenous trees, such as Alnus and Betula, whose inflorescences are not highly specialized; and at the return to the moss-like or frond-like form of degenerate water plants, e. g., Lemna, Wolffia and Myriophyllum. The essential similarity in the life processes of all the higher plants, pteridophytes and phanerogams, is a fact familiar since the days of Hofmeister, and is constantly receiving confirmation. For instance, Stengel has recently described the beautiful transition in anatomical structure and origin between the macrosporangia (ovules) of gymnosperms and angiosperms. The discovery of such analogies is one of the great achievements of modern botany, making it possible, by embryology and histology, to trace the ascent from mosses to exogens, picturing to us the development which geology shows has been going on in time.

Variation is the source and presupposition of this development. Change of conditions and cross-fertilization are the two great known causes of variation. The first, in the case of fixed plants works slowly; the second includes within itself the advantages of the first and others of its own; for by it the characteristics of dissimilar parents, whose differences are to a certain extent the results of the dissimilarity of the conditions to which they have been subject, are transmitted in varying proportions to succeeding generations. New properties are thus acquired and old ones changed, and the variable descendants of crossed plants conquer the unimproved offspring of self-fertilization.

The process of conjugation in the lowest plants in which there is a sexual reproduction, in almost all cases makes probable the union of the spores of two distinct individuals (Spirogyra, Mucor, Desmidiaceæ, Diatomaceæ, etc.), while the same possibility of cross-fertilization is insured among the higher thallophytes, liverworts and pteridophytes by motile antherozoids, which are so small that the moisture of the damp places in which

the prothallium or sexual generation always grows is sufficient to carry them, sometimes at least, to the germ cells of distinct plants. The wind, too, helps as the means of scattering the asexual spores from which the sexual generation grows.

Among phanerogams the power of elongation of the antherozoid-bearing pollen tube takes the place of the movement of the antherozoid itself, but still the asexual spores of pines, grasses, sedges, and of many forest trees are carried by the wind to the oospheres which they fertilize. Most of these anemophilous plants are probably old types; the Coniferæ, for example, which are all anemophilous, are acknowledged to have been the precursors of the higher monocotyledonous vegetation. They are all anemophilous. Geologists tell us that monocotyledons appeared before exogens; their structure is simpler and they are in many respects a connecting link between these and gymnosperms. Five of the 22 orders of endogens described in Gray's Manual (revised edition) are anemophilous, a large proportion; one is partly wind-, partly water-fertilized; several others are largely hydrophilous, also a primitive method common among degraded water plants such as Vallisneria and many Naiadaceæ.

The very fact that whole orders of endogens have this characteristic of wind-fertilization proves it to be an ancient one, for the features which are common to all members of an order are necessarily as old as the order itself, and the possession of the same property by several orders of a class indicates still greater age. The wide distribution of some of their genera (there is none wider among phanerogams) and the comparative lack in variety of the Cyperaceæ, Gramineæ, Juncaceæ, Eriocauleæ and Typhaceæ point to the one conclusion, that these wind-fertilized endogens are among the oldest of flowering plants.

For somewhat similar reasons many of the anemophilous dicotyls may be considered old types. They are almost all apetalous—a sign of low development; a sign, too, of old age, for the apetalous was the dominant type of dicotyls in the mid-Cretaceous, forming forty-five per cent of them as against fourteen per cent now. This decrease in numbers is suggestive of extinction and another mark of old age. Further, of the twenty-three apetalous orders represented in our flora, six are anemophilous. These are the Salicaceæ, Cupuliferæ, Myricaceæ, Juglandaceæ, Platanaceæ and Piperaceæ. (Excep-

tion must be made of the genus Salix which has developed means of insect attraction). Of these the Salicaceæ are known to be old, for the oldest fossil dicotyledons are of the genera Salix and Populus. None of them include many genera, and this again is a common attribute of old orders and a sign of approaching extinction, according to Darwin's rule that the dominant orders are those of numerous genera and species.

Piperaceæ	include	8	genera	and	1000	species.
Platanaceæ	"	1	"	"	6	"
Juglandaceæ	"	5	"	"	30	"
Myricaceæ	"	1	"	"	35	"
Cupuliferæ	"	10	"	"	400	"
Salicaceæ	"	2	"	"	200	"

The genera are conspicuously few. The Piperaceæ alone have a large number of species and of their method of fertilization I am not sure. The group Saurureæ, represented in our flora, is apparently adapted to wind-fertilization. Moreover many members of the Chenopodiaceæ, Amarantaceæ, Polygonaceæ, Urticaceæ and some Empetraceæ are anemophilous. All this is in marked contrast to the state of things among the younger and more highly developed exogens. For of the 50 polypetalous orders one is partly wind, partly water-fertilized; of the 33 gamopetalous orders, only one is largely anemophilous, and of that one, the Plantagineæ, the typical genus is considered by some authorities to be degraded.

Here, too, the question of color comes to our aid. In every one of these ten apetalous orders the predominance of greenish inflorescences is very noteworthy as a further sign of low organization and of relationship with glumaceous endogens, pines, and pteridophytes. F. F. Mott[1] says that dull color means the absorption of vibrations of every wave length; deep red, deep violet or green that about two-thirds of the wave lengths are absorbed, about one-third reflected; scarlet, yellow, blue or purple that about one-third of the wave lengths are absorbed, about two-thirds reflected. He adds that these three stages of color show therefore three stages of progress in the direction from generalization to specialization, a progress such as marks all development. Accordingly we should expect to find, as we do, greenish and dull shades prevalent among the least highly organized, and

[1] American Naturalist, Sept. 4, 1890.

therefore, other things being equal, the oldest inflorescences. On the other hand, among the dominant forms of to-day, the greatly specialized Compositæ, Umbelliferæ, Leguminosæ, Orchidaceæ, Labiatæ, Scrophulariaceæ, Rubiaceæ, Ericaceæ, etc., bright reds, blues and orange yellows are common. There are 23 orders of the world flora which contain 1000 species or more. Inconspicuous flower clusters are characteristic of only five of these, viz: the Cyperaceæ, Gramineæ, Urticaceæ, Piperaceæ and Euphorbiaceæ. The first and second are very old types, the third and fourth apetalous (probably old), the last degenerate.[1] It seems then logical to call these inconspicuous, little protected clusters of stamens and pistils ancient forms of flowers and to consider wind-fertilization, which is so common among them, a primitive method.

But the crossing of individuals must be a most desirable thing if it is to be obtained at such enormous cost, for pollen is precious material, yet for every grain which the wind carries to an ovule thousands are swept to destruction. Self-fertilization would apparently be a much surer and cheaper process. The end, however, justifies the means, otherwise crossed plants would long ago have yielded place to self-fertilized victors. Darwin, by a most careful and elaborate series of investigations of more than a thousand plants, has shown that "wherever plants which are the offspring of self-fertilization are opposed in the struggle for existence to the offspring of cross-fertilization, the latter have the advantage. In no single case was the advantage on the other side."[2] So wind-fertilized plants waxed strong and multiplied on the face of the earth.

Meanwhile "away back in the darkness of the coal period, when tree-ferns, calamites and giant club-mosses combined with archetypal yews to people the steaming swamps of a hot, cloud-laden island world, there existed a strange form of insect which can only be compared to the cockroaches of our day, but which seems to have embodied in its structure the beginnings of all the varied types of insect life, the promise and

[1] White and yellow are the predominant colors of our own flora; 420 yellow, 614 white species among the 2056 flowers of Gray's Manual (revised edition). It would be interesting to know whether there is a larger proportion of reds and blues in the tropical lands where flower-frequenting birds and butterflies are more abundant. Wallace's statement of the surprising monotony of tropical vegetation is not necessarily opposed to this

[2] H. Müller.

prophecy not only of our dragon-flies, and beetles, but also of our flies, bees and butterflies."[8] Scudder sums up what was known of American fossil insects about nine years ago in this way: "The species of fossil insects known from North America number eighty-one; six of these belong to the Devonian, nine to the Carboniferous, one to the Triassic and sixty-five to the Tertiary epochs; the Hymenoptera, Homeoptera and Diptera occur only in the Tertiaries; the same is true of the Lepidoptera, if we exclude the Morris specimen, and of the Coleoptera with the Triassic exception. The Orthoptera and Myriopoda are restricted to the Carboniferous, while the Neuroptera occur both in the Devonian and Carboniferous formations." Packard says: "the lower forms of Hymenoptera, so far as the scanty records show, appeared first in the Jura formation."

From these statements its seems probable that the period of the appearance of dicotyledons was also the time of the development of our great groups of insects. The two have been hand in glove ever since. Insects wandered to and fro seeking what they might devour, and if the man is blessed who makes two blades of grass grow where only one was, thrice happy is the insect which discovers an entirely new source of nourishment by which its food supply is many times multiplied. Accidentally lighting on a staminate flower cluster, as I have seen bees and flies do on the wind-fertilized inflorescences of Poterium Canadense, it finds itself in the land of plenty and thereafter is on the outlook for food-magazines of the same kind. The flowers with highly colored bracts (represented in the flora of to-day by some species of Euphorbia and Amarantus), or those with colored stamens, (such as species of Thalictrum, Corema and Plantago now show as the first step toward insect attraction), being more conspicuous will be more frequently visited. Visitors leaving the flowers carry with them pollen which clings to the hairs of their bodies, and some of this will occasionally be left on the feathery stigmas of the pistillate clusters which will also be visited, at first in vain. The ovules so fertilized ripen seeds which inherit the peculiarities of their parents to a greater or less degree.

This is then, as far as we know it, the story of the origin of flowers, which were at first merely axes bearing spirally ar-

[8] Lester F. Ward.

ranged reproductive organs, such as the antheridial and archegonial clusters of mosses or the spore-bearing stalks of ferns and equisetums. The growth of bracts, i. e., leaves altered to do protective work, and the further development in the macrosporangium mouth of the mucilaginous secretion already foreshadowed in the archegonia of ferns, produced the characteristic inflorescences of gymnosperms. The position of a plant, as of a man, in the scale of progress, is measurable by the protection given to the children and by the manner of their preparation for independent life. The increase of ovule-shelter by the formation of a closed ovary is an easy step, as the comparison of the ripened pods of Mitella, Tiarella, Aquilegia or almost any of the Leguminosæ with the ovule-bearing scales of pines, shows. By the incurving of the edges of one of these scales, or more probably, by the persistence of the inrolling of the edges of the young leaf, an ovary perfect in every essential would be produced, and the favorable variation transmitted to succeeding gererations.[1] Still further provision for the safety of the seeds and for their advancement in life, is attained by increased development of the protective bracts to form organs such as the perigynia of sedges, the glumes and awns of grasses, the hairs of Eriophorum, etc.; more complete adaptation to wind-fertilization by the formation of microsporangium stalks (filaments, sometimes feebly developed in the Coniferæ) and of feathery outgrowths (stigma) from the united tips of the carpellary leaves.

Then the lords of horticulture, the insects, with an eye to profit, began their investigations of the fields, at first obtaining only pollen from these wind-tossed inflorescences. In some cases they never find anything more, e. g., in Hepatica and Papaver. But the occurrence of sugary secretions,

[1] Some time after writing this sentence, I came across a remarkable confirmation of the truth of the theory in Eichler's "Blüthendiagramme," part II, p 216. He says: "In most Resedaceae the carpels are so united that they form a one-celled ovary with parietal placentae, . yet they remain free from one another at the top, nor do the edges of the individual carpels close together there, so that the ovary is open above . The condition of things is somewhat different in Reseda luteola, Caylusea and Astrocarpus In the first species the individual carpels remain separate, their edges turned inwards and meeting below to bear the ovules in the ordinary way, but not touching above so that each carpel is open far down on its inner suture In Caylusea there is neither union of the carpels, nor closing together of the edges of each one separately; the ovary *appears therefore to be made of five or six free scales which stand in a circle*—a very primitive structure, not occurring elsewhere in this form." The state of things in Tiarella cordifolia seems to me to correspond well to this description of the pistils of Reseda luteola

common elsewhere, as on the petioles of the passion vine and on the leaves of the larch where bees busily search for them, among the floral organs is a not surprising result of the energy of the currents which nourish anthers and ovules.[1] Such secretions at first perhaps not abundant, nor perceptibly sweet, will be gradually increased and improved by means of this co-working of plant and insect. Stages in the evolution of nectar and of nectar-protecting organs are represented to-day, steps which connect the watery fluid found exposed the first day of blossoming in the stigmatic cavity of Nymphæa tuberosa, the drops of liquid at the bases of the carpels of Caltha, the honey protected by scales on the petal bases of Ranunculus and by elongated petal-bases (i. e. spurs) of Aquilegia, etc., with the showy buckets of Marcgravia from which the brilliant sun birds of India drink nectar worthy of the gods.

The result of this long-standing partnership is, that, in the place of a world of green, corolla-less flowers, our meadows are rich with the gold of daisies and buttercups; our hillsides, covered with the blue of innocence; our rocks, purple with clematis, or gay with columbine; asters and golden-rods reflect royal colors in the brooks; gentians give back the blue of the sky from the mountain pastures; and there are glorious fringed orchids for those who can find them, and they are the bees and butterflies. For the good poet was mistaken in supposing that many a flower is born to blush unseen. The bees who have made it blush will surely be there to see.

Ithaca, N. Y. [*Concluded next month.*]

Mt. Kataadn and its flora.

F. LAMSON-SCRIBNER.

In August, 1874, a party of gentlemen from Bangor and Orono, under the direction of President M. C. Fernald of the Maine State College, made the ascent of Mt. Kataadn for the purpose of determining more accurately than had before been done, the altitude of the mountain. This work was accomplished by Prof. Fernald in a very thorough and accurate manner, and his observations were made public at that time.

Mr. F. W. Hardy, a well known photographer of Bangor,

[1] cf. BONNIER: Comptes Rendus, LXXXVIII 662.

accompanied the party and succeeded in obtaining some excellent stereoscopic and other views of the mountain and its surroundings.

From Bangor we proceeded by rail to Mattawamkeag, thence thirty-five miles by stage to Sherman. From the latter place we were carried with our baggage, by private conveyance through Stacyville to "Hunt's Farm", on the banks of the East Branch, a distance of ten miles. An excellent guide was procured at Stacyville, in the person of Mr. J. C. Stacy, a gentleman who very faithfully served us on a similar excursion the year before.

Hunt's Farm was then owned by a Mr. Patterson, a stalwart and obliging man who had about him a large family of bright and healthy boys and girls. Mr. Patterson's nearest neighbors were distant about six miles, and his hospitable dwelling, which served as a hotel for the lumbermen in the winter season, was the last one on our route to the mountain. We crossed the river in a bateau and the remaining twenty miles of our journey were through a continuous forest, which we traversed on foot. There was a good logging road to within two or three miles of the mountain, so that our walk was not a severe one. Indeed a person might ride on a sure-footed horse the greater part of the distance. Within the first six miles we twice forded the Wissatiquoik River, which empties into the East Branch near "Hunt's Farm". The fords were easily and quickly accomplished, but at the second crossing our task became more laborious for we were then obliged to assume the burden of our provisions and blankets which thus far had been transported by horses.

Five miles farther on, at the foot of Kataadn Lake, we had our first good view of the mountain, sharply and boldly defined against the western sky. The sight inspired us with new courage and enthusiasm, and after a brief rest we hastened on, and near the close of the third day from Bangor we arrived at the foot of grand old Kataadn, with its naked summit majestically towering directly above us. After a good night's rest and an early breakfast we prepared for the real labor of our excursion, that of the ascent, but with it came the real enjoyment which we so long held in anticipation.

Without a load one may ascend the mountain from the foot of the eastern spur, or "ridge" as it is termed, and return in a day. But a person unused to such scenery will form but a

vague idea of the mountain if he makes but one ascent. He must ascend and reascend; he must dwell upon its lofty peaks and view in varying lights its grand proportions; he must descend its vast slides filled with decomposed granite and immense boulders that appear as though the slightest push would send them rolling down the mountain side; he must descend the "long crooked slide", where by a slip he might be dashed upon the sharp rocks hundreds of feet below or where an incautious step might set in motion an avalanche of huge boulders; he must pass down into the "notch" and over the "chimney"—a feat seemingly impossible to the inexperienced. The "narrows" must be traversed, where there is barely a footing and from whence a jump of more than two thousand feet may be made upon the one hand or a tumble hardly less great upon the other. The "northern tablelands" must be visited, and the mountain "basin", where exists a small lake of the purest water. This basin is enclosed upon three sides by perpendicular walls of solid rock, nearly two thousand feet high. All this must be done and more, ere one can obtain any correct impression of the grandeur and immensity of this mountain.

Situated in the eastern part of Piscataquis County, and in the very heart of the lake and mountain scenery of Maine, Mt. Kataadn stands without a rival in New England in the wild grandeur of its proportions: and in its alp-like character it has no equal in the Eastern States. The altitude, as determined by the observations of Prof. Fernald, is five thousand two hundred and fifteen feet, making this mountain the highest point of land in the state and but a little lower than Mt. Washington in New Hampshire. The views to be obtained from its summit can hardly be surpassed either in beauty or extent. The peculiar features of the flora of this locality cannot fail to be of interest to the student of botany, and it is our purpose to present in this paper some botanical notes made during our stay upon the mountain.

Upon a previous visit (in 1873) we made the ascent by the way of the "eastern slide", which is, perhaps, the easiest if not the best place for the purpose. Around the base of this slide a small form of the white birch is the prevailing tree; probably *Betula papyracea*, var. *minor* Tuck. Ascending the slide, this tree rapidly dimishes in size, till finally it becomes a mere dwarf and disappears entirely before reaching the first

"horseback". The lower portion of the mountain is covered with a dense growth of dwarf black spruce, so dense as to be wholly impassable, except by tumbling or rolling over the summits of the closely growing trees.

At the foot of this slide along the borders of a cold mountain stream, grows the bright-flowered *Arnica mollis* Hook. Dr. Goodale in the Report of the Maine Board of Agriculture for 1862, in speaking of this plant, says: "It is found sparingly near Moxie Falls, a few miles from the forks of the Kennebec. It occurs in great beauty and profusion in the vicinity of the cataract of Parlin Pond stream, where its orange flowers are sprinkled with the spray of the falling water. The iridescence of the flowers as they were bathed in the sunlight and spray was a spectacle of much beauty, the orange blossoms here and there, overpowering the rainbow coloring of the drops of water."

Nearly half way up the slide, an ice-cold spring issues from the side of the mountain, and its waters, rushing down over the steep rocks, form the brook just alluded to. Along this stream the green mountain alder, *Alnus viridis*, grows in luxuriance. Above the spring this shrub gives way to more alpine forms: we soon meet the dwarf birch (*B. glandulosa* Mx.), a rather pretty little shrub abundant on the high mountains of New England and New York, and growing as far north as Hudson's Bay. Fruited specimens less than three inches high were gathered on the "horseback". With the birch and extending above it, we find the little mountain cranberry, *Vaccinium Vitis-Idæa*. This is a low spreading shrub with numerous short, upright branches. The berries are numerous, of a dark red color, with an acid taste. They are gathered and made into sauce, like the common bog cranberry. The sweet berries of the bog bilberry, *V. uliginosum* L., and mountain blueberry, *V. cæspitosum*, refreshed us on our tedious ascent. At the summit of the slide, occurring quite frequently and rising but an inch or two above the rocks on which it grew was Cutler's willow, *Salix Cutleri* Tuck. It may be recognized by its strongly veined, elliptical leaves. With this species occurs also *S. herbacea* L., a species of even smaller habit than the last.

Forming dense, convex mats over the surface of the rocks is the curious *Diapensia Lapponica* L., a small evergreen plant of the Phlox family. The remains of the white flowers, which

appear in July, were still present. As we neared the summit of the slide, the crowberry, *Empetrum nigrum* L., made its appearance. This is a small, prostrate, much branched shrub, with very numerous, narrow leaves, giving the plant a heath-like aspect. The flowers open in early summer. In August, the plants were loaded with small black berries. Ascending the "Horseback" towards the "Chimney", we passed large patches of the beautiful little mountain sandwort, *Arenaria Grœnlandica.* The flowers of this species are quite large when compared with the plant and are of a delicate white tint.

Upon our present trip we started from Reed's camp and proceeded through dense groves of tall spruce trees, which became smaller and yet more dense as we advanced towards the eastern spur, up which we were to climb, and such a climb! With our packs upon our backs, and no path, not even a spotted line to direct our course! We come upon huge boulders over which we must climb, or around which we must force our way through an almost impenetrable forest of dwarf birch and stunted fir. By dint of perseverance and severe exertion, we labor upward; now walking almost upon the very tops of the low but wide expanded evergreens, now losing our footing and slipping helplessly into dark caverns between high and mossy rocks. Two hours, or perhaps more, of this travel and we are above the growth of trees and have passed through that dense growth of vegetation called by the woodsmen "pucker-brush". We are now more than three thousand feet above the sea level. Our birch tree exists only as a low shrub and soon gives way to another species, the little *Betula glandulosa*, which rises but a few inches above the rocks upon which it grows, or rather to which it clings. About us there is still to be seen an occasional spruce, but so reduced in size that we can hardly recognize in it any relationship to the majestic forms that clothe the hills now far below us. For how many centuries the stunted forms before us have braved the severe mountain storms and fierce winters we know not, but that their whole existence has been one constant warfare with the untamed elements their meager and ancient appearance will testify—the vertical trunks rising but a few inches above the stony soil, the densely grown and thickly clothed branches carpeting the rocks like some sharp leaved moss. A few steps upward and we are in the midst of plant forms that belong to the frigid zone. Here in profusion we find the small moun-

tain blueberry, *Vaccinium cæspitosum*, the mountain cranberry, *V. Vitis-Idæa*, and the heathlike crowberry, *Empetrum nigrum*, plants that abound in Greenland and furnish berries that form the only vegetable diet of the dwellers in that arctic country.

The only species peculiar to Mt. Kataadn is *Saxifraga stellaris*, var. *cômosa*. The other forms, so far as noted, are identical with those upon the White Mountains and other high altitudes in the United States. The upper limit of erect shrubs is between three and four thousand feet.

Below is a list of those plants observed upon the mountain or in its vicinity.

1. *Clematis verticillaris* DC. Abundant along the banks of the East Branch, in fruit. This vine grows in profusion at Orono, Maine, where it blooms about the 25th of May.

2. *Cardamine bellidifolia* L. In the "Long Crooked Slide" which runs down from near the highest peak of the mountain.

3. *Arenaria Grœnlandica* Spreng. Common on the rocks of the Eastern Ridge, or "Saddleback". Although perfectly at home upon the bleak mountain tops of New England, it is sometimes found in Maine upon the rocky river banks near the sea.

4. *Saxifraga stellaris* L. var. *comosa* Willd. Found only under the shade of rocks on the ridge north of the summit of the mountain. The flowers of all the specimens I saw were changed into little tufts of green leaves.

5. *Epilobium alpinum* L. Only one or two specimens seen in the "Basin" of the mountain.

6. *Linnæa borealis* Gronov. Common in damp woods throughout the State, blossoming about the middle of June. I found it growing in damp moss on several of the lower points of the mountain in bloom at the time of my visit (Aug. 15).

7. *Nardosmia palmata* Hook. Noticed in swamps near the mountain. It grows in great abundance at Orono, Maine.

8. *Aster graminifolius* Pursh. On dry rocks of the East Branch.

9. *Solidago Virga-aurea* L. var. *alpina* Bigel. In several places on the mountain. This is a bright little species of golden-rod and often expands its heads of golden yellow flowers barely an inch above the rocks on which it grows.

10. *Solidago thyrsoidea* E. Meyer. Common, especially

in the "Long Crooked Slide", and near the northern "Table Lands".

11. *Gnaphalium supinum* Villars. On rocks in the "Basin" The specimens were out of bloom.

12. *Arnica mollis* Hook. Near the foot of the Eastern Slide and also along the borders of a lake near the "Eastern Spur" of the mountain, where it is very abundant.

13. *Cirsium muticum* Mx. Common near the mountain.

14. *Nabalus nanus* DC. Common on the higher portions of the mountain, especially near the northern "Table Lands".

15. *Nabalus Boottii* DC. With N. nanus, but not so abundant.

16. *Lobelia Kalmii* L. Abundant on rocks along the East Branch. I have also found this plant on the banks of the Kennebec at Waterville.

17. *Campanula rotundifolia* L. A diminutive mountain form grew in the "Notch" near the "Chimney". The plants were only four inches high, simple, terminated by a single flower.

18. *Vaccinium Vitis-Idæa* L. Common especially on the "Saddleback". Upon the shady and moss-covered rock-shelves on the north side of the "Chimney", specimens were gathered in flower. This is the mountain cranberry of the north. The slightly acid, refreshing berries are collected in quantities for making sauce and preserves.

19. *Vaccinium uliginosum* L. Common.

20. *Vaccinium cæspitosum* Mx. Is a very small species producing sweet, blue berries,—also common.

21. *Vaccinium Pennsylvanicum* Lam. The alpine variety of this species (var. *angustifolium*) grows on the north "Table Lands."

22. *Chiogenes hispidula* T. & G. Common on the lower portion of the mountain, also in swamps throughout the state.

23. *Arctostaphylos alpina* Spreng. Quite common on the higher altitudes. In fruit.

24. *Cassiope hypnoides* Don. This charming little heath-like plant I found only on the eastern edges of the north "Table Lands". The plants were in fruit.

25. *Kalmia glauca* and *K. angustifolia*. Found on the "Saddleback". The former in flower.

26. *Phyllodoce taxifolia* Salisb. Common along the "Narrows".

28. *Rhododendron Lapponicum* Wahl. North "Table Lands".

29. *Loiseleuria procumbens* Desv. On rocks north of the summit, common.

30. *Moneses uniflora.* In flower on the northern portions of the mountain and throughout the state in cool swamps, blooming about the last of June.

31. *Diapensia Lapponica* L. Abundant on the "Saddle-back". In fruit.

32. *Polygonum viviparum* L. Found only in the "Long Crooked Slide," in flower and fruit.

33. *Empetrum nigrum* L. Very abundant in the eastern portion of the mountain.

34. *Betula papyracea* Ait. var. *minor* Tuck. Common on the lower portions of the mountain.

35. *Betula glandulosa* Mx. Common on the mountain. Well fruited specimens less than three inches high were collected.

36. *Alnus viridis* DC. Common on lower slopes along streams.

37. *Salix argyrocarpa* Anders. Common.

38. *Salix herbacea* L. On the "Saddleback", in moss.

39. *Scheuchzeria palustris* L. In a bog near the mountain.

40. *Listera cordata* R. Br. In flower in the sag between the summit and the north "Table Lands."

41. *Orchis dilatata* Gray. Common in the swamps near the mountain.

42. *Luzula parviflora* Desv., var. *melanocarpa.* Abundant.

43. *Luzula spicata* Desv. Common.

44. *Juncus filiformis* L.

45. *Juncus trifidus* L. Common.

46. *Scirpus cæspitosus* L.

47. *Carex scirpoidea* Mx. Abundant on the eastern dome of the mountain.

48. *Carex canescens*, var. *vitilis.* At the very summit of the mountain.

49. *Carex lenticularis* Mx. In the "basin".

50. *Carex rigida* Good. var. *Bigelovii.* On the "narrows", and also in great abundance northwest of the summit.

51. *Carex pulla* Good. ? On the shores of the little lake in the "basin".

52. *Cinna pendula* Trin. Along streams near the mountain.

53. *Calamagrostis Canadensis.* Along the mountain brooks.

54. *Poa laxa*, Hænk. On the "Saddleback".

55. *Aira flexuosa* L. Common.

56. *Hierochloa alpina* R. & S. On the "Saddleback".

57. *Lycopodium Selago* L. Abundant along the "Narrows", etc.

58. *Lycopodium annotinum* var. *pungens.* On the Eastern Ridge.

NOTE.—The foregoing article was written in 1874, the nomenclature therefore conforms to that of the 5th edition of Gray's Manual.—F. L. S.

Knoxville, Tenn.

Noteworthy anatomical and physiological researches.

Observations on the protection of buds in the tropics.[1]

While no little attention has been given to the way in which buds are protected from the cold of rigorous climates it would appear that similar adaptations to guard the delicate parts of plants from the hot and dry atmosphere and the direct rays of the sun in tropical regions have been the occasion of much less study, although this is quite as distinct and considerable a field of research. Treub called attention to the need of such adaptations in 1887, and gave several instances of their occurence. The paper of Potter here summarized is, however, the first to give any satisfactory classification of the various methods employed by different plants, so far as the writer is able to discover. "For the purpose of description," says Potter, "it is convenient to consider these special protective contrivances under four heads," as follows:

1. Protection by means of stipules. 2. Protection by means of gum. 3. Protection by position assumed when young. 4. Protection by shade from older leaves.

Species of Artocarpus, Heptopleurum, Canarium, Wormia and Sarcocephalus are cited as examples of the first class. In all these the stipules form a hood over the young leaves and thus protect them from the too scorching rays of the sun. Of the second class Tabernæmontana is mentioned as particularly interesting. In at least one species of this genus the young leaves develop in a four-sided chamber, the walls of

[1] M. C. POTTER: Journ. Linn. Soc. XXVIII, 343-352.

which are, on two sides, older leaves, and on the other two, thin layers of gum. As an instance of the third case the orthotropic position of folded palm-leaves is mentioned. It would scarcely seem permissible to put forward a case like this as an instance of special adaptation, for, as is well known, it is generally true that rolled-up dorsiventral organs are inclined to take the erect position. Undoubtedly, nevertheless, such a position is of decided value to the young leaves and parts of leaves for it clearly serves to put them in the least exposed position with reference to the incident rays of a hot tropical sun. Many examples of this manner of protection may be found among the monocotyledons in particular. The last method of protection is a favorite one and is by no means confined to plants growing in the tropics. Uvaria, Gossypium and Begonia are the examples cited by Potter. In each of these genera when a leaf has become old enough to resist the hot rays of the sun and the unfavorable conditions of the atmosphere it is quite natural that it should be utilised as a protecting shield for the immature leaves which are less able to withstand conditions varying so widely from the optimum.

Some good figures are given in the plates which accompany the article, and, with the exception of the third, each class is illustrated.—CONWAY MACMILLAN.

Vitality of ferns.

Wittrock publishes in a recent paper[1] a series of observations, which form together a very valuable contribution to the biology of the ferns. It deals especially with the ability of fern-leaves to imbibe water and to become fresh after a long period. Several species are described as showing this power and the author has observed that a special form of the frond is characteristic of each species, when naturally dried. Most interesting, however, is the chapter in which the author demonstrates the ability of the ferns to be revivified after being kept dry for several months or even years and after being preserved as herbarium specimens! Professor Wittrock has taken, for instance, several species from the Pringle-collections immersed them in water for some minutes and then planted them in moist sandy soil, keeping them carefully in shade and under an ordinary glass globe. The ferns became perfectly

[1] V. B. WITTROCK: De filicibus observationes biologicae. Acta horti Bergini, vol. 1. no. 8. Stockholm, 1891.

fresh and developed new leaves and roots, although some had been preserved in herbaria for two years and three months. The Mexican plants which Prof. Wittrock succeeded in reviving were: *Scolopendrium nigripes; Asplenium furcatum, A. Pringlei; Polypodium Plumula, P. lanceolatum; Cheilanthes lendigera, C. Szovitsii; Isoetes Pringlei. Selaginella lepidophylla*, the well-known resurrection-plant, was also cultivated, and specimens which had been kept dry in a jar for more than eleven years revived. The paper is illustrated by five partly colored plates.—THEO. HOLM.

Anatomy of carices.

A very comprehensive study of the anatomical structure of about fifty species of *Carex* has been made by M. Mazel, forming a very welcome addition to the papers which deal with anatomical characters of species. Although the author admits that he has not succeeded in finding any characters in this genus sufficient to characterize the different groups of species, he has at least made a beginning by enumerating a considerable number of peculiarities in the internal structure which undoubtedly may serve in the future as a basis for a more complete study of this genus. It seems, however, that the species selected for examination are not quite sufficient to illustrate the whole genus anatomically. For it must be remembered that we have here to do with an exceedingly large genus, of which the representatives are spread all over the world and living under the most different conditions as to climate and soil. This has not been taken into consideration, and instead of selecting about fifty species, all European excepting one, it would have been more advisable to examine the same number representing other parts of the world. North America posesses very many and most interesting species of *Carex*, which ought not to have been passed by in a "comparative" anatomical study. The Arctic region also has a considerable number of types, many of which appear again farther south, and of which the structure is better suited to illustrate the genus anatomically than a number of species from a relatively small territory. It would also have been highly desirable for the author to give a sketch of the modified structure in the varieties of a few species. This is for in-

ANTOINE MAZEL: Etudes d'anatomie compareé sur les organes de végétation dans le genre Carex. pp. 213 7 plates. Genève 1891.

stance well marked in the different forms of *Carex vulgaris, hirta*, etc.

It is a little curious to see that the author considers the character of hairiness as being so very rare in Carex, and that he only mentions this fact for *C. hirta*, while it is also to be found in *C. pallescens, pilosa* and many North American species, e. g., *C. virescens, castanea, aestivalis* and *triceps*.

But otherwise this paper contains many interesting details and proves a skillful and careful research. The first chapter gives a general view of the structure of the vegetative organs, while the second contains a microscopical analysis of the species.

Concerning the leaf-structure the author points out several divergences, taken from the epidermis itself, the stomates, the epidermal expansions, the strength of the stereome, the distribution and shape of the mestome bundles, the reservoirs, etc. Among the reservoirs the author has discovered that those containing tannin are present in several species. He has observed them in the mesophyll, close to the lacunes and just under the epidermis. This is the more interesting since the Cyperaceæ formerly like the Gramineæ and the Ranunculaceæ were considered exceptional in not possessing any reservoirs.[1] The author has, however, not only observed them in the leaf but also in the aerial stem and the rhizome of certain species.

The general structure of the leaf seems to be very uniform, there being a whole series of intermediate forms between the nearly triangular leaf of *C. Davalliana* and the broad and flat leaves of *C. maxima, riparia* and others.

There is also given a very detailed account of the tissues in the aerial stem and the rhizome. The aerial shows like the leaf a general plan, which is, however, still more distinct than in the leaf. The epidermis does not show so many differences as in the leaf with its superior and inferior face, and it is rather difficult to observe any essential divergences. It might seem that the sharply triangular stems of several species would furnish reliable characters so as to distinguish them from those in which the stem is nearly terete ; but the author calls attention to the fact that the same stem is often not triangular in its whole length.

Among the characters derived from the stem it may be men-

---

[1] Cfr Sachs: Vorlesungen über Pflanzenphysiologie 1887, p 186.

tioned that the mestome-bundles form a different number of rows in certain species, varying from one to four as in *C. Grayii.* The rhizome shows even in its external anatomy a few characteristic differences, if we consider the stoloniferous and cespitose forms. But the internal structure gives still more and very characteristic differences, observable in the stereome, the lacunes, the endodermis, etc. As to the root, the author has observed also here a certain variation. The endodermis and the pericambium does not form a closed ring in all species, but the latter is most often interrupted by the hadrome, as described by Van Tieghem as characteristic for Xyrideæ, Eriocaulaceæ, Juncaceæ and a few other families.

The author is undoubtedly correct, when in the following chapter, where he gives an anatomical sketch of the species in question, he remarks that the characters to some extent may prove to be of specific value, but that it would be impossible from the present study to draw any conclusion as to the mutual relationship of the species described.—THEO. HOLM.

BRIEFER ARTICLES.

Cryptomitrium tenerum Austin.—Mr. O. F. Cook of Syracuse University had the kindness to send me, on my request, a specimen of the above named hepatic, which, being rather imperfectly described by its author, I have undertaken to examine thoroughly, so that the exact systematic position of this very interesting plant may with safety be established. Before going into details as to the relationship of this plant, I give a description of it, as follows :

CRYPTOMITRIUM TENERUM (Hooker) Austin.

Marchantia tenera Hooker in Kunth. Syn. plant. I. p. 45

Duvalia tenera Gottsche· Synopsis Hepat. p. 554.

Plantae frondosae, terrestres, membranaceae, tenerae, minorés, virides, arcte repentes.

Frons oblonga, repetito furcata vel monopodialiter ramosa (furca fertili brevi, altera furca solum increscente). Adsunt etiam rami steriles cum basi angustata ex apice frondis orti vel alii rami adventivi postici e costae latere orti. *Costa* pro plantae tenuitate sat crassa, angusta, in alas sensim attenuata, sub alis evanida, cellulis aequimagnis (corticalibus minoribus) aedificata, *alae* latissimae valde attenuatae, margine tenuissimo unistrato. *Stratum* aëriferum humile, cavernosum; *cavernae* amplae unistratae vacuae i. e. filis vel laminulis acces-

soriis, haud repletae, lamellis unistratis formatae. *Stomata* parum elevata, exigua, cellulis 5–6 radiatis superficialibus constantia, *poro* minimo vel fere nullo, interdum tamen majore cellulisque apice convexo-prominentibus stellaeformi. *Cellulae epidermidis* parvae, haud incrassatae.

Squamae posticae biseriatae, parvae, remotae, purpureae vel violaceae, late ovatae, varie lobatae, lobis superioribus appendiculo filiformi munitis. *Radicellae* incrassatae e basi paginaque squamarum ortae.

Inflorescentia monoica. *Androecia* flori femineo approximata, *antheridiis* in medio costae uniseriatis, saepe totam costae longitudinem occupantibus; *ostiola* conica, pallida. *Pedunculus* capitulorum ex apice costae — strato hypoporo recedente — ortus, basi apiceque nudus, longus, tenuis, bicanaliculatus, irregulariter sulcato-carinatus. *Capitula* feminea circularia, disciformia, antice leniter convexa, 5–6 costata, costae radiatae humiles papulosae, in centro capituli crassae; capitula versus marginem valde attenuata, margine ipso regulariter denseque crenata, postice plana, 5–6 locularia; *loculi* radiatim positi, capituli marginem haud attingentes, involucrati; *involucra* e margine loculorum orta, ovalia, parva, inflata, monogyna, parietibus crassis parenchymaticis, longitudinaliter fissa, labiis conniventibus quasi clausa, tempore maturitatis tenuibus apertis. *Calyptra* tenuis, basi bistrata. *Capsula* sphaerica, vix exserta, bulbo sphaerico affixa, pedunculo subnullo, operculo dehiscens, pariete tenui exannulifera, unistrata. *Elateres* longiusculi bispiri. *Sporae* brunneae, tetraëdrae, reticulatim lamellatae, dilute limbatae.

HAB.— California. Mexico (*Humboldt*).

If we compare this plant with other genera of the order of Marchantiaceæ its close affinity to *Duvalia* is undoubted; it has the same minute stomata, reduced to 5 or 6 conical cells with a very small pore in the center; in both the assimilating stratum consists of a single layer of caverns, which in Duvalia, however, have numerous secondary scales growing out of the walls and sometimes connate to the opposite wall. The postical scales in both genera are very irregularly lobed and dissected, not seldom down to the very base, so that the biseriate arrangement is somewhat obscured. The inflorescence is monoicous in both; in *Duvalia*, however, the male organs, which in Cryptomitrium stand just behind the female peduncle, spring from different branches of the plant; in both the androecia are not pedunculate and the antheridia, as in *Riccia*, are immersed in the substance of the frond; they produce small conical ostiola, which are arranged in a long row; in Duvalia they are united into a small roundish disk and surrounded by minute lanceolate scales.

The female receptacle or capitulum of both genera has a long peduncle, which springs from the end of the costa, being a continuation of the frond, of which the cavernous stratum is left behind (which in *Marchantia*, for instance, is carried up to and may be found in transverse sections of the peduncle on its antical side); in Duvalia this peduncle has but one furrow, in Cryptomitrium two; the female receptacles are very different and justify the separation of Cryptomitrium from Duvalia, being disciform in the former and almost spherical in the latter; the rays of the receptacle in Duvalia are incurved and on the postical side united into a fleshy annulus, which surrounds the end of the peduncle in form of a short vagina, while in Cryptomitrium they are stretched out and united into an uninterrupted plane and fleshy disk; in both genera, however, the involucra spring from the postical side of the substance *between* the rays, contrary to other genera, (*Grimaldia*, *Clevea*. and others) in which the rays themselves are developed into involucra.

There are no perianths and the capsules of both genera open with an operculum. Spores and elaters do not show any material differences.

There could be traced numerous other affinities and distinctions with regard to other Marchantiaceæ; but this would exceed the scope of this article and would involve me in a great many morphological and anatomical details, which I leave to the study of those who read German and are, therefore, able to understand Leitgeb's "Untersuchungen über die Lebermoose," the only scientific work on the development and anatomy of these plants which is very exhaustive, though our plant was not known to its author.— F. STEPHANI, *Leipzig*.

Pyrus Ioensis.— Professor A. S. Hitchcock tells me that at St. Louis Pyrus Ioensis (see American Garden, XII. 469, Aug. 1891,) is clearly distinct from *P. coronaria*. Among other differences, P. Ioensis holds its fruit longer than the other. He gives me the following note of its fruit: "Fruit about 25 mm. high and 30 mm. in diameter. Peduncle 30 mm. long, with two scars. Apple sunken at each end, where it is pubescent; color green or slightly yellowish. Lenticels rather prominent and numerous. Fruit falling October 26th."—L. H. BAILEY, *Cornell University, Ithaca, N. Y.*

EDITORIAL.

AN INTERNATIONAL CONGRESS OF BOTANISTS is an exceedingly valuable thing, provided it is really what the name implies. If, however, the real botanists, whom we would delight to honor, stay at home, and we

have let loose upon us a crowd of quasi-botanists, such a class as is more apt to journey far to congresses than any other, our lines will not have fallen to us in pleasant places. The men we want to visit us are busy, very busy, and are little given to take such long trips for manifestly cosmetic purposes. It would be a phenomenal thing to secure even a fair representation of the real botanists of Europe. There will be great danger, a danger seen lurking around even so conservative a body as our American Association, of confounding a foreign label with one of distinction. The percentage of smatterers and cranks is probably as large in other countries as in the United States, and it is well known that such classes travel further and talk more profusely than any other. We will have to show our good judgment, therefore, not in indiscriminate but in proper recognition.

NOTHING would so arouse the active interest of American botanists in this venture as an announcement by the local committee that has the affair in charge, of the names of distinguished foreign botanists who have signified their intention of being present. American botanists will enthusiastically entertain their foreign brethren, and along with the grain will endure a reasonable amount of chaff; but they cannot be expected to endure all chaff. It is not to be expected that the perfunctory invitations of the committee will secure all the desired attendance. These invitations must be supplemented by those urgent private ones sent by acquaintances and correspondents. It is the latter kind that really count. The International Congress will probably be a success if every American botanist will privately urge the attendance of his foreign friends.

IF THE CONGRESS becomes really representative, its discussions will carry great weight; and any of its decisions with reference to modes of procedure will probably be recognized. If, however, it proves to be a body whose representative character may well be called in question, no such decisions should be promulgated. More important than the nomenclature questions, which, like the poor, we have always with us, are questions of uniform terminology with reference to plant structures, a uniformity that is not so much to avoid confusion of names as confusion of ideas. This will open a vast field of usefulness to the congress, provided always that it is representative, which is to say competent.

OPEN LETTERS.

Suggested by Kuntze's "Revisio Generum Plantarum."

In recent years many changes of well established names have been made solely to satisfy the law of priority, and not owing to any difference in judgment as to generic or specific rank. In some instances this has been carried so far as to abandon long established and household words for names wholly unknown and often inappropriate, because the latter were published a year earlier, or even not any earlier, but simply on the preceding page of the same book, or still logically, say, in the preceding paragraph or line.

When we have objected to calling Nymphæa *Castalia*, or Carya *Hicoria*, or Magnolia grandiflora *M. fœtida*, our mouths have been stopped by the law of priority, and our ruffled tempers have been smoothed by the assurance that all of these vexatious changes were *in the line of stability*, that it would take only a few years to get accustomed to calling Jones *Brown* and Smith *Thompson*, and after the first little inconvenience and strangeness all would settle down into blissful permanency. The mild suggestion that, owing to the different judgments of men and the zeal of future antiquarians we might be simply opening the floodgates to an increased instability, has generally been received by the innovators with bland incredulity. But, to show how the thing really works, now comes along Kuntze with his tremendous *Revisio Generum Plantarum*, and finds it necessary to make 30,000 changes in specific names before he can publish his description of species collected in a journey round the world! Alas, in obedience to the new dictum, or dictator, for he speaks *ex cathedra*, we must no longer call Jones *Brown*, and Smith *Thompson*, but must hereafter call Jones *Baker*, and Smith *Jenkins*. By the irony of fate, we are shown very clearly just how much stability some of the more recent and distressing changes are likely to have. E. g., Nymphæa becomes Leuconymphæa (1737) and Castalia is no more. In the same way Carya becomes Scoria (1808) and Hicoria is shelved. Corydalis becomes Capnodes; Dicentra, Capnorchis; Glaucinium, Mosenthina; Lepidium, Nasturtium; Claytonia, Calandria; Ionidium, Calceolaria, and Calceolaria something else; Elatine, Potamopithys; Oxalis, Acetosella; Pelargonium, Geraniospermum; Rhus, Toxicodendron, and so on *ad desperandum*. Even names which have stood more than 150 years, like Liriodendron Tulipifera and Zea Mays have to be converted into Tulipifera Liriodendron and Thalysia Mays to satisfy the ghost of some dead botanist, and the zeal of a live antiquarian.

Old debts become *outlawed* after a time, and it would simplify matters greatly to apply the same practice to old names. There seems almost no end to the changes a persistent rummaging of old literature can bring to light, and we may be certain it will not end with Kuntze. For one, I most devoutly wish the strict law of priority were at the bottom of the sea. It does seem that it would be better to study nature more and parchments less. But the proof of a pudding is said to be the eating, and this closely printed book of a thousand pages is commended to the digestion of Messieurs, the systematists.— ERWIN F. SMITH, *Washington, D. C.*

NOTES AND NEWS.

A "CONSPECTUS FLORÆ AFRICÆ" is promised by Messrs. Durand of Brussels, and Schinz of Zürich.

THE ENTIRE EDITION of the *Proceedings* of the Society for the Promotion of Agricultural Science for 1891, which was ready for mailing, was burned in the fire at Columbus, Ohio, January 26th. Re-printing the edition has already begun.

MR. C. W. SEELYE, of Rochester, N. Y., has published "A list of the indigenous ferns of the vicinity of Rochester, with notes," a reprint from Proceedings of the Rochester Academy of Science. Of the 53 species of ferns credited to New York state in the Torrey club list, the flora of the vicinity of Rochester contains 35.

A LONG and able article on "Climate and plants" was read by Professor L. H. Pammel before the Iowa Horticultural Society at its meeting in January, 1891, and is published in the Monthly Review of the Iowa Weather Service for October last. It treats the subject from many sides, and contains a wealth of citations.

AMONG the recent bulletins from the experiment stations is one on "Some fungous diseases of the grape" by F. Lamson-Scribner, and one on "Electricity in agriculture" by Clarence D. Warner. The latter has also been published in *Science* for January 15, and is to be commended to those curious in such matters for the utter lack of logical basis for its conclusions.

THE ANNALS OF SCOTTISH NATURAL HISTORY issues its first number with the new year. It is a successor to the *Scottish Naturalist,* and resembles it in form and matter, but is much improved in both, and contains new departments. It is devoted to developing a knowledge of the flora and fauna of Scotland, both recent and fossil. The present number contains 84 pages and two excellent plates. It is a quarterly.

THE UNIVERSITY OF INDIANA has just purchased the entire herbarium of Mr. F. H. Horsford, of Charlotte, Vermont. The collection is very complete in its display of New England and Canadian plants, besides that general assortment of plants which comes into the hands of a collector. The collection is remarkable for the beauty of its specimens, many of them being the handiwork of Mr. Pringle, with whom Mr. Horsford has been so long associated.

THE FOLLOWING botanical papers were presented before the Iowa Academy of Sciences at its December meeting: Some experiments for the purpose of determining the active principles of bread-making, by Miss Minnie Howe; The action of disinfectants on nutrient media, by W. B. Niles; Slime molds of Iowa, by T. H. McBride; Bacteria of milk, Report of committtee on state flora, Phenological notes, and Experiments in prevention of corn smut, by L. H. Pammel.

IN AN EDITORIAL upon the Royal Gardens, Kew, *The Gardener's Chronicle* (Jan.2) gives an account of its rapid and splendid development since its establishment in 1841, and suggests needed extensions in two directions, viz: a staff of workers to investigate plant diseases, and another for the systematic and coöperative study of the minute anatomy of plants. The suggestion is surely a timely one. It is per-

fectly possible for this great establishment, with its unrivaled opportunities, to become "the center of energy" in many departments.

PROFESSOR WITTROCK gives in a recent paper[1] a very interesting account of the life-history of *Linaria Reverchoni*, a new species collected in Spain. The cotyledons, two or even and quite frequently three, are lanceolate-spathulate, suddenly attenuated towards the apex, which thereby forms like a terminal lobe. There is a long hypocotyl, from the base of which adventitious buds develop and soon grow out, while the main shoot finishes its growth at a very early stage and without any development of either flowers or vegetative buds. The propagation of this species is therefore dependent upon the formation of these adventitious shoots, which are terminated by an inflorescence, besides which they may also branch and often carry a few secondary inflorescences.--T. H.

AGRICULTURAL SCIENCE, founded by Professor C. S. Plumb five years ago, and ably conducted by him up to the close of last year, has been transferred to Professor Wm. Frear of the State College, Pa., who will in future assume the financial and editorial management. Professor Frear has secured the coöperation of sixteen prominent investigators, who will give editorial assistance in the several departments of agricultural activity. Only one of these, Professor F. L. Scribner, is a botanist, and to him is assigned the duty of looking after "botany and mycology," according to the prospectus. The "and" in that triplet of words is a pretty sure indication that the management is not especially familiar with the several departments of botany, and probably does not appreciate its present scope or its importance as a science underlying a large proportion of agricultural operations. The journal has occupied an important place in the past; and it deserves hearty support under the new relations.

PROFESSOR LESTER F. WARD'S paper on "Principles and methods of geologic correlations by means of fossil plants," read before Section E of the A. A. A. S., Washington meeting, is printed in the *American Geologist* (Jan.). Of course it is a strong putting forward of the claims of paleobotany by one of its most competent exponents; but a point of special interest to botanists is the retort made by the author to the general botanical accusation of paucity of material and uncertainty of results. Stating that paleobotany has added not a little to our knowledge of botany proper, the author proceeds to say: "For example, it is the habit of botanists to figure leaves so carelessly that the paleobotanist is unable to tell the genera to which they belong. This is chiefly due to the fact that they ignore, as a rule, the exact nervation of leaves, and are content to figure them almost from the standpoint of the artist, merely for the sake of the effect. Paleobotany has taught the botanists that the nervation of leaves is important, and that wherever possible it should be carefully figured. We are indebted to fossil plants for the discovery that nervation in leaves is of generic rank, whereas form, upon which the botanist chiefly relies, is usually only of specific rank." Botanists must confess to myriads of figures of leaves, in which the nervation is merely conventional.

---

[1] *De Linaria Reverchoni* n. sp. observations morphologicae et biologicae. Acta horti Bergiani, vol. I. no. 4, Stockholm, 1891.

BOTANICAL GAZETTE

MARCH, 1892.

Flowers and insects. VII.

CHARLES ROBERTSON.

MARTYNIA PROBOSCIDEA Glox.—I know of but one station for this plant—on the banks of the Macoupin Creek, where it appears to be indigenous.

The pale bluish corolla measures about 5½ cm. in length, its tube about 3½ cm. The tube within is finely spotted with bluish; on the lower wall there are about three orange lines leading from the narrow part of the tube and expanding in a large spot on the lower lip. The throat above is spotted with reddish, on the sides with bluish. The middle lobe of the lower lip is streaked with bluish and is straight, while the others are reflexed.

The anthers lie against the upper wall in the median line, with their cells directed longitudinally. The stigma is in advance of them and closes when touched, as observed by Delpino.[1] The narrow part of the tube is about 8 mm. long which with other characters of the flower seems to indicate an adaptation to long-tongued bees. I have found the flowers in bloom from Aug. 19 to Sept. 14. Sept. 3, 1890, I saw *Bombus americanorum* F. ☿ sucking the honey, its thorax being streaked with pollen.

At Metropolis, Ill., Aug. 14, Mr. C. A. Hart found it visited by *Xenoglossa brevicornis* Rab. (MS.) ♂ ♀.

DIANTHERA AMERICANA L.—The plant is rather common in shallow water of streams, the stems rising from 3 to 9 dm. and bearing small clusters of purplish flowers.

The flowers are proterandrous. The two-lobed upper lip stands erect and is strongly marked with purple. The lower lip is formed by three widely divergent lobes, which are white, the middle one with much purple.

---

[1] Sugli apparecchi delle fecondazione nelle piante antocarpee, 1867.

A straight stamen stands on each side. The anther cells are widely separated; one stands vertically, facing the corresponding cell of the other stamen; the other, the outer one, is placed horizontally and has its dehiscent surface turned upwards. The stamens stand so erect that at first I wondered how the bee would come in contact with them. I also wondered why the anther cells are at right angles to each other. As a rule, only two flowers are in bloom in the umbel-like cluster at a time. The three lobes of the lower lip, which we have observed are strongly divergent, are curved upward, so that it is most convenient for the bee to enter between the middle and one of the lateral lobes. In this way it is apt to brush the vertical face of the inner anther-cell. To reach the other flower, the bee crawls directly upwards and approaches it from above. In crawling up out of one flower and down into the other the bee is likely to touch the horizontal faces of the outer anther-cells.

The corolla tube is about 5 mm. long, so that the nectar can be obtained by tongues of medium length. The flower is evidently adapted to bees, but is often visited by flies and butterflies. I have found it in bloom from June 23 to Aug. 24. On July 5 and 9 I observed the following visitors:—

Hymenoptera—*Apidae:* (1) Apis mellifica L. ☿, s., ab.; (2) Bombus virginicus Oliv. ☿, s.; (3) Melissodes palustris Rob. ♂, s., ab.; (4) M. bimaculata Lep. ♂♀, s., ab.; (5) Ceratina dupla Say ♀, s.; (6) Epeolus lunatus Say ♂♀, s.; *Andrenidae:* (7) Agapostemon nigricornis F. ♀, s.; (8) A. radiatus Say ♂♀, s.; (9) Augochlora pura Say ♀, s. and c. p., ab.; (10) Halictus lerouxii Lep. ♂♀, s., ab.; (11) H. ligatus Say ♂♀, s.; (12) H. fasciatus Nyl. ♂♀, s.; (13) H. pilosus Sm. ♀, c. p.; (14) H. confusus Sm. ♀, c. p., ab.

Diptera—*Syrphidae:* (15) Allograpta obliqua Say, f. p.; (16) Mesograpta marginata Say, f. p.; (17) Sphærophoria cylindrica Say, f. p.; (18) Eristalis tenax L., s. and f. p.; (19) Helophilus laetus Lw., f. p.; (20) Tropidia quadrata Say, s., freq.; (21) Syritta pipiens L., f. p.

Lepidoptera — *Rhopalocera:* (22) Pieris rapae L.; (23) Phyciodes nycteis D.-H.; (24) Lycaena pseudargiolus B.-L.; (25) Pamphila metacomet Harr.; (26) Pholisora catullus F.—all s.

VERBENA STRICTA Vent.—The plant is quite common. The stem rises from 5 to 10 dm. and bears numerous erect spikes of blue flowers.

The corolla tube rises directly upward, bending outward above and joining the vertically expanded border, which is five-lobed and somewhat two-lipped, expanding from 6 to 12 mm. The tube is about 5 mm. long, is quite narrow and is closed at the mouth by a dense circle of hairs.

The flowers appear homogamous and I see nothing to prevent an insect's proboscis from carrying pollen from the anther back to the stigma of the same flower, though if the proboscis is thoroughly dusted with pollen from another flower, cross-pollination may be more likely.

I have found the flowers in bloom from June 15 to Sept. 16. On nine days, July 9—Aug. 7, I observed the following insects sucking the nectar:—

Hymenoptera—*Apidae*: (1) Apis mellifica L. ☿; (2) Bombus virginicus Oliv. ♂; (3) Melissodes aurigenia Cr. ♂; (4) M. perplexa Cr. ♂♀, ab.; (5) Ceratina dupla Say ♀; (6) Epeolus mercatus F. ♂; *Sphecidae*: (7) Ammophila procera Klug.

Lepidoptera—*Rhopalocera*: (8) Pieris protodice B.-L.; (9) P. rapae L.; (10) Danais archippus F.; (11) Pamphila peckius Kby.; (12) P. cernes B.-L.; (13) Pholisora catullus F.; (14) P. hayhurstii Edw.; (15) Eudamus tityrus F.

Diptera—*Bombylidae*: (16) Exoprosopa fasciata Mcq. ab.; *Conopidae*: (17) Stylogaster neglecta Will.; *Syrphidae*: (18) Eristalis tenax L.

VERBENA HASTATA L.--This plant is less abundant than the last, grows taller and bears small spikes and smaller blue flowers.

The border is 3 to 5 mm. across and the tube 3 or 4 mm. in length.

I have found it in bloom from July 12 to Sep. 23. On 8 days, July 12—Sept. 7, the following insects were observed visiting the flowers for nectar:—

Hymenoptera—*Apidae*: (1) Apis mellifica L. ☿, ab.; (2) Bombus americanorum F. ♂; (3) B. separatus Cr. ☿; (4) Epeolus remigatus F.; *Andrenidae*: (5) Agapostemon radiatus Say ♂; (6) Augochlora pura Say ♂, ab.; (7) Halictus lerouxii Lep. ♂♀; (8) H. fasciatus Nyl. ♂, ab.; (9) H. zephyrus Sm. ♂; *Sphecidae*: (10) Ammophila pictipennis Walsh.

Lepidoptera—*Rhopalocera*: (11) Pieris protodice B.-L.; (12) Pholisora catullus F.; (13) Eudamus tityrus F.

Diptera—*Bombylidae*: (14) Systoechus vulgaris Lw.; (15) Exoprosopa fasciata Mcq., ab.

VERBENA URTICAEFOLIA L.—The flowers are white, much smaller than in the preceding, and are arranged in long loose spikes. Blooms from June 29 to Sept 7, or later. On 8 days July 11—Aug. 29, I observed the following insects, all sucking:—

Hymenoptera—*Apidae*: (1) Apis mellifica L. ☿; (2) Bombus americanorum F. ♂☿; *Andrenidae*: (3) Augochlora pura Say ♂; (4) Halictus ligatus Say ♀; (5) H. confusus Sm. ♀.

Diptera—*Empidae*: (6) Empis clausa Rob. (MS.); *Conopidae*: (7) Stylogaster neglecta Will.; *Syrphidae*: (8) Mesograpta geminata Say; (9) Sphaerophoria cylindrica Say; (10) Syritta pipiens L.

Lepidoptera—*Rhopalocera*: (11) Pieris protodice B.-L.; (12) P. rapae L.

PHRYMA LEPTOSTACHYA L.—The plant grows in damp woods and is not very common. I have found it in bloom from July 10 to Sept. 3. The stem rises about 6 dm. high and bears several branches terminating in slender spikes, which commonly show but two flowers open at a time.

The flower and its three-lobed lower lip project horizontally, the short, slightly notched upper lip diverging in an upward direction. The corolla is white, tinged with pinkish, the upper lip being almost entirely pink. It measures 8 mm. in length, its tube 5 mm., the lower lip 4 mm. in width. The lower wall of the corolla is strongly infolded forming a sort of palate which presents on each side a ridge provided with numerous stiff hairs. This structure narrows the entrance so as to exclude short tongues and to require long tongues to touch the anthers and stigma. Small bees can force their heads into the tubes by forcing down the palate. The flowers are strongly proterandrous, and are visited by *Augochlora pura* Say ♂.

PHYTOLACCA DECANDRA L.—The stems of this common plant rise 2 m. or more, are much branched and bear numerous racemes of small whitish flowers. The five ovate, white sepals are incurved but expand so that the flower measures about 5 mm. across.

The flowers are proterandrous with a homogamous stage. Cross-fertilization between flowers of the same or of distinct plants may occur, and even self-pollination may occur by in-

sect aid. In absence of insects spontaneous self-fertilization may readily take place.[1]

The nectar is exposed. The flowers are visited by short-tongued Hymenoptera and Diptera, especially species of Halictus. I have found the plant in bloom from June 14 to Oct. 15. On July 17 and 23 I observed the following visitors:—

Hymenoptera—*Apidae*: (1) Apis mellifica L. ☿, s.; *Andrenidae*: (2) Halictus ligatus Say ♂, s.; (3) H. fasciatus Nyl. ♂, s.; (4) H. confusus Sm. ♀, s. and c. p., ab.; (5) H. zephyrus Sm. ♀, s.; (6) H. stultus Cr. ♂♀, s. and c. p., ab.; *Vespidae*: (7) Polistes metricus Say, s.; *Pompilidae*: (8) Priocnemis fulvicornis Cr., s.

Diptera—*Empidae*: (9) Empis clausa Rob. (MS.) s.; *Syrphidae*: (10) Mesograpta geminata Say, s.; (11) Syritta pipiens L., s., ab.; *Tachinidae*: (12) Jurinia apicifera Wlk. s.

HYPOXIS ERECTA L.—This plant is quite common in prairies and woods. The scapes, generally one to each plant, rise one or two dm., usually exposing only one open flower at a time. The flowers are yellow. the lanceolate divisions expanding horizontally from 12 to 25 mm. The six stamens are strongly divergent, the stigma occupying the centre of the circle, so that in absence of insects self-pollination cannot occur, unless it happens after the flowers close.

As a rule, insect visits result in cross-fertilization between distinct plants, but may also result in self-pollination.

The flowers are visited only for pollen, and depend especially upon Halictus. I have found them in bloom from April 28 to June 12. May 19 and 22 I observed as visitors:—

Hymenoptera—*Apidae*: (1) Ceratina dupla Say ♀, ab.; *Andrenidae*: (2) Augochlora pura Say ♀, ab.; (3) Halictus pectoralis Sm. ♀; (4) H. coriaceus Sm. ♀; (5) H. ligatus Say ♀; (6) H. cressonii Rob. ♀; (7) H. stultus Cr. ♀; (8) H. tegularis Rob. ♀; (9) H. anomalus Rob. ♀—all collecting pollen.

Diptera—*Syrphidae*: (10) Mesograpta geminata Say; (11) Sphaerophoria cylindrica Say; *Anthomyidae*: (12) Chortophila sp.

Coleoptera—*Buprestidae*: (13) Acmaeodera culta Web.—all feeding on pollen.

ERYTHRONIUM ALBIDUM Nutt.—This is one of the first flowers of spring, and is quite common. The flower bud ap-

[1]According to Meehan, Proc. Acad. Nat. Sci. Phil 1890, 272, the flower is spontaneously self-fertilized before opening.

pears with a pair of leaves and rises on a scape only a few centimetres above the ground. Owing to a bend in the scape, the flower looks outward and downward, or directly downward. The divisions of the perianth are white, tinged with purplish exteriorly, and marked with yellow at the base within, especially the three petals, which hold nectar on the bases of their claws. At base the divisions are closely approximated, forming a tube about 15 mm. in length, and making the nectar hard to reach except by insects with long tongues; beyond they are directed outward and downward, or may be expanded horizontally so that the flower measures 65 mm. across, or they may be so strongly reflexed that their tips meet, as in the case of plants growing in rich bottom soil.

The anthers of the three outer, shorter stamens dehisce first. At this time, if an insect come with pollen, it will leave some upon the stigma, which is somewhat in advance of the dehiscent anthers; otherwise, it may effect self-pollination. Cross-fertilization may readily occur at any time, but when the inner anthers dehisce, they may easily leave some of their pollen upon the stigma, since they usually surpass the stigma a little. Accordingly, in absence of insects, I think that self-pollination commonly occurs.

The pendulous position of the flower has the effect of restricting the visitors almost exclusively to bees, since they can readily cling to the stamens and style. The first flowers, which appear before flower insects become common, are visited almost exclusively by hive-bees.

For the attention of insects the plant is in competition with Anemonella thalictroides, Isopyrum biternatum, Sanguinaria Canadensis, Viola palmata, Claytonia Virginica and Dentaria laciniata. Competition with Claytonia is most severe; I have found it difficult to collect the visitors of Erythronium until afternoon, after the flowers of the Claytonia had closed.

I have found the plant in bloom from Mar. 17 to Apr. 22. On 13 days, between Apr. 7 and 19, I saw the flowers visited by:—

Hymenoptera—*Apidae*: (1) Apis mellifica L. ☿, s. and c. p., ab.; (2) Bombus virginicus Oliv. ♀, s., one; (3) Ceratina dupla Say ♂, s.; (4) Osmia atriventris Cr. ♂, s., ab.; (5) O. albiventris Cr. ♂♀, s., ab.; (6) O. lignaria Say ♂, s.; (7) O. latitarsis Cr. ♂, s.; (8) Nomada luteola Lep. ♂, s., ab.; *Andrenidae*: (9) Andrena bicolor F. ♂♀, s., ab.; (10) A. sayi Rob. ♂, s.; (11) A.

erythronii Rob. ♂♀, s. and c. p., ab.; (12) A. mariae Rob. ♀, s.; (13) Halictus lerouxii Lep. ♀, s.; (14) H. fasciatus Nyl. ♀, s.; (15) H. confusus Sm. ♀, s.; (16) Colletes inaequalis Say ♂, s. ab.

Lepidoptera—*Rhopalocera*: (17) Pieris rapae L., s.; (18) Colias philodice Godt., s.; (19) Nisoniades juvenalis F., s.

Diptera—*Bombylidae*: (20) Bombylius fratellus Wd., s., one; *Syrphidae*: (21) Brachypalpus frontosus Lw., f. p., one; *Muscidae*: (22) Lucilia cornicina F., s., not touching stigma.

TRADESCANTIA VIRGINICA L. (smooth form).—The plant is smooth and glaucous with linear leaves, the stems rising 3 to 6 dm. and bearing from one to three umbel-like clusters of flowers, each umbel in turn with from 1 to 5 open flowers. The flowers are blue, expanding 3 or 4 cm., but retaining a shallow, bell-shaped form. The stigma is widely separated from the anthers and somewhat surpasses them. Spontaneous self-pollination is hardly probable while the flower is open. Cross-pollination between flowers of the same plant may occur, but owing to the small number of flowers exposed on one plant at a time, cross-pollination between flowers of distinct plants is much more probable.

The flowers are specially adapted to female bees, and other insects in search of pollen. The hairs on the stamens are foot-holds for the use of bees in collecting pollen.

The plant is in strong competition with Rosa humilis for the attention of pollen-visitors, Tradescantia having the advantage of abundance and Rosa of conspicuousness. But they avoid competition to some extent by dividing the visitors between them, Rosa taking the large ones and Tradescantia the small ones.

I have found it in bloom from May 22 to July 30. The following list of visitors was observed on June 4, 5 and 12:—

Hymenoptera—*Apidae*: (1) Bombus pennsylvanicus DeG. ♀; (2) Bombus separatus Cr. ♀; (3) Synhalonia speciosa Cr. ♀; (4) Ceratina dupla Say ♀; *Andrenidae*: (5) Agapostemon nigricornis F. ♀; (6) Halictus pruinosus Rob. ♀—all c. p.

Diptera—*Syrphidae:* (7) Syrphus ribesii L.; (8) S. americanus Wd.; (9) Allograpta obliqua Say; (10) Mesograpta marginata Say; (11) Sphaerophoria cylindrica Say; (12) Tropidia mamillata Lw.

Coleoptera—*Curculionidae*: (13) Stethobaris sp.—all f. p.

Carlinville, Ill.

Evolution in methods of pollination.

ALICE CARTER.

[*Concluded from p. 46.*]

Among animals, the phase of natural selection known as sexual selection comes to the front in the production of many things which we call beautiful or curious, such as the gorgeous colors of male birds and butterflies, the horns of beetles and reindeer, the tusks of boars and elephants, the chirping of crickets and the songs of birds. (It is noteworthy, here as elsewhere, how similar organs have been independently developed for similar ends in most widely different classes of organisms.) The higher plants, however, because of their fixed position, are removed from the power and influence of sexual selection, and its offices of the production of attractive qualities are performed for them in a most remarkable way by the agency of insects. Insect selection takes the place of natural selection, and to it we largely owe the fragrance, color and form of our beautiful flowers.[1] This is one side of the picture ; the animals themselves are the other. Side by side with the flowers they frequent they have themselves been changed, their proboscides lengthening with the flower tubes, their bodies becoming better adapted to the forms of the blossoms and to the carrying of the pollen, their wits sharpened to find the means of getting at the hidden honey with the least possible loss of time and strength, and to read quickly the posters hung out by the plants, which enable the more intelligent customers to distinguish one kind of flower from another, and show them when the time for visiting is reached or passed. So now, instead of the primeval cockroach-like creatures, there are insects as varied and wonderful in form and structure as the flowers they frequent.

This subject is full of interest, and since the time of Darwin has been widely studied, but the knowledge accumulated should be put into form convenient for every day use. If, as we believe, flowers have been produced by a gradual adapta-

[1] The variations — the presuppositions of progress — are, of course, inherent in the plant nature, produced by causes not yet fully understood. The insects have simply chosen and therefore perpetuated those best adapted to their own needs which must also of necessity be those which are advantageous or at least not injurious, to the plants themselves

tion to the reciprocal wants of plants and their visitors, from fructifications essentially like the spore-bearing spikes of the heterosporous Equisetums of which geologists write, this ought to be known by every student, and everyone should be able to see from the manual that, in each order, the method of fertilization is to a certain extent an index of the degree of specialization of the reproductive apparatus, the most important part of the plant. In many orders there is a most beautiful transition from anemophilous (usually polygamous, monœcious or diœcious) species through almost exclusively self-fertilized hemaphrodite ones to those that are incapable of self-fertilization. For example, in the Ranunculaceae, in the gradation from the wind-blown inflorescences of polygamous Thalictrums to the inconspicuous, almost exclusively self-fertilized flowers of Myosurus minimus; from this to the genus Ranunculus (whose small-flowered species, such as R. abortivus and R. sceleratus closely resemble Myosurus in the arrangement of the carpels and stamens, while the large species, R. repens, R. bulbosus, etc., are abundantly visited and crossed); from Ranunculus to Aquilegia, and from Aquilegia to Delphinium and Aconitum, there is a suggestion in the compass of a single order of the probable historical development of irregular, brightly colored, greatly specialized, insect-fertilized forms from the grass-like or pine-like, spore-bearing stalks of the ancestors of our dicotyledons.

At a certain stage of development, these changing plants will be perfectly adapted to neither wind nor insect fertilization; then those individuals whose stamens and pistils are borne in adjacent clusters, or better yet, within the same bracts, will be most sure of ripening seed. Clavaud says: "There does not exist a diœcious plant which cannot exceptionally offer the two sexes upon the same stalk." The common occurrence of stamens in the pistillate, and of pistils in the staminate clusters of trees and other plants described as monœcious or diœcious, is known to every observer. Such variations, sometimes perhaps preserving the lives of the plants which possess them, will be passed on to their descendants. In other words, hermaphrodite flowers may have arisen from unisexual ones, as unisexual ones are now actually being produced from hermaphrodite (e. g. in many genera of Labiatæ, in some species of Silene). So it comes to pass that though the majority of wind-fertilized plants have the sexes

separated, almost all entomophilous ones have stamens and pistils in the same flowers. Müller therefore considers diclinism to have been the original condition of phanerogams, from which hermaphroditism has been developed by natural selection. Darwin takes exactly the opposite view. But it hardly seems necessary to adopt either exclusively, for both hermaphrodite and unisexual forms are common among the lower plants. Why cannot both forms have been transmitted from the pteridophyte-like ancestors of phanerogams? Diclinism and bisexualism may be collateral branches, one not necessarily older than the other, though in many individual cases it is evident that one has been, or is being derived from the other.

When a plant has become adapted either to self or insect fertilization there is no longer necessity for the production of vastly greater quantities of pollen than can be used, for either method is more sure than dependence upon wind agency. Frugal nature then turns the energy no longer needed for spore formation into another channel. Some of the stamens, losing their power to produce pollen, may become exclusively organs of attraction. Numerous transition stages are represented in the genera Thalictrum, Clematis, Nymphaea, etc. The origin of brighter color may be like that of nectar (BOTANICAL GAZETTE, vol. XV, p. 177) a result of the unusually active life processes in connection with the strong current necessary to supply the ovules and anthers with materials required for the development of their richly fed spores. The same principle is at work which Wallace and others have shown to prevail among animals, whose highly colored organs are, as a rule, those which are most continually exercised; e. g. the wings of butterflies, the wings, tails and beaks of birds, etc.

Again, the rule that among animals a great number of similar segments is a mark of low organization, seems to hold good here. Contrast the numerous stamens and pistils and the variable number of petals or sepals of water lilies, buttercups and anemones with the small and always constant number characteristic of the aristocratic families, the Violaceæ, Compositæ, Labiatæ and Scrophulariaceæ. This decrease in the number of the floral organs is often accompanied by further specialization by the union of their individual members to secure still better protection of the pollen, honey and ovules and better adaptation to the agents of pollination.

When cross-fertilization by means of insects has become assured, the color, time of flowering, fragrance, the length of the corolla tube, the form and position of the petals and sepals, all have reference to time of flight and character of the especially invited guests. Every hair has a meaning. Every curve is an adaptation. The power of self-fertilization, at first indispensable, may become useless. A struggle for existence arises between the two methods and the least efficient goes to the ground. So cross-fertilization is, as a rule, alone possible among the majority of orchids, some Compositæ, some species of Salvia, Aconitum, Corydalis, Dianthus, Malva and others. Many changes, progressive and retrogressive, are still going on. It is known that the honey of more than one hundred and thirty-two flowers can be plundered from outside without the touching of the stamens or stigma. In these cases at least, perfection has, not been reached; but the wonderful contrivances to prevent the entrance of useless guests, such as hairs on the calyx, corolla or stamens, slipperiness of the corolla, a pendent position of its tube, or the accumulation in the petals of matters offensive to insects, show that some species are on the high road to it.

So much for flowers; but there are weeds, hundreds of them, widespread and homely. Many, perhaps all, of those which have the rudiments of calyx and corolla are degraded forms, descendents of species once fertilized by insects, but which, because of the extinction of the particular ones on which they either depend, or because they have spread into regions where these insects are not, or because thrown into the shade by the superior attractions of their neighbors, have been obliged to resort again to wind agency (Plantago?), or to adapt themselves to almost exclusive self-fertilization (Veronica hederæfolia). In either case there is no longer need of attractive organs and the petals have accordingly been reduced. The evil effects of continued self-fertilization may have had a share in this result; but probably not to a great extent, for such effects will be largely counteracted by the wide dissemination so characteristic of weeds, by which these low forms are exposes to great variation of climatic conditions. The loss is then of beauty, not of strength. Change of environment seems often to have as beneficial results as cross-fertilization in the stimulation of the life processes and the production of varieties. The degradation here, as elsewhere, is only a peculiar form of adaptation.

The theory that, by whatever means gained (by the crossing of individuals if possible, if not by self-pollination), the great object of plant-life is the production of seed, the continuance of its species, receives further support by the presence in many of the forms, most beautifully adapted to the visits of insects, of cleistogamic flowers. These are minute, never-opening flowers whose stamens produce very little pollen (from 100 to 400 grains in contrast to the 243,600 of Leontodon or the 3,654,000 of Peony), but the anthers are in close contact with the stigma, none of the pollen is wasted and the inevitable self-fertilization causes the ripening of seed enough to secure the the existence of the species, if for any reason the more conspicuous flowers are not visited. Kuhn enumerates 44 genera which have flowers of this kind; Darwin adds 12 (Viola, Impatiens, Lespedeza, Specularia, Campanula Lathyrus, etc.) May it be this small form which alone survives in some degraded species?

Such study has led me to many delightful hours spent in watching the visits of insects to flowers, with, for one result, great respect for Darwin's famous aphorism, "nature abhors perpetual self-fertilization." For though I waited a long time often, sometimes for days together, to "win the secret of some weed's plain heart," the flower lover was almost sure to come at last in the form of buzzing bombuses for the two species of Monotropa, a tiny fly for the little shore pin weed (Lechea thymifolia), clumsy bugs for the honeyless, dull-colored purple trillium (Trillium erectum), pollen eating bees and flies for the homely ragweed (Ambrosia artemisiæfolia.) During the last spring, summer, and autumn I caught a thousand insects on one hundred and forty-three species of plants (one of a kind on each). One hundred and thirty-one of these flowers are visited by Hymenoptera, fifty-seven by Lepidoptera, sixty-two by Diptera, seven by the ruby-throated humming bird. I shall not soon forget the first sight of a humming bird draining dry the nectar cups of the columbine (Aquilegia Canadensis); nor the daily visits which he afterwards made to the trumpet honeysuckle, trumpet creeper, fraxinella, Petunia, Lunaria, Rhododendron, or Rhodora; nor the silent watching in the evening for the ghost-like, dusky-winged humming bird moth, whose capture is as memorable as that of a boy's first six-pound salmon; nor the dark evening when a valiant sweep of the net over the

Japanese honeysuckle captured a supposed humming bird moth which proved to be only a June bug. The beautiful clear-winged moth (Sesia), whose first visit to the Azalea of the botanic garden was so sudden and brief that after long waiting vainly for his return I almost concluded that he had been the delusion of an excited imagination, afterwards proved himself a capturable reality and we enjoyed the further acquaintance with his family through their visits to Lunaria, Hydrophyllum, Dictamnus, Syringa, and Vinca. The memory of the gorgeous red butterfly which twice visited the smooth sumach (Rhus glabra L.), eluding our nets both times never again to appear notwithstanding our patient waiting and the reward offered for his arrest, will haunt me through the winter months and until the shade of one of his descendants joins the full ranks of those who met death on the sumach field.

Botany and zoölogy at the start are one, but when the debatable ground occupied by organisms neither animal nor vegetable is passed, each has a clear country until paths cross again in this region of reciprocal plant and animal selection. If the descent theory is true, a natural system of classification which shall show true relationship is, to some extent, possible. Such a classification has been largely adopted for the lower plants, and it will come for all. Then the standard manual of botany will no longer separate what nature has joined together; the gymnosperms will not stand between the sister classes of angiosperms, nor gamopetalous between the polypetalous and apetalous exogens. The relationship which all acknowledge will be clearly shown. The arrangement of species in each order will be a story in brief of the development of the order itself, the means of fertilization being an important factor of the determination of the comparative degree of specialization of each species. Then too we shall do away with the undignified jump from phanerogams to cryptogams, using instead the natural ladder which has been stretched between them, the gymnosperms, whose life history is in some respects so like that of pteridophytes, in others so like that of close-ovaried plants that it is hard, impossible indeed, to say to which they are most closely related. Our classification will follow the teachings of geology, histology, embryology, and common sense, and, standing on the vantage ground of a manual founded on the brotherhood

of plants, we can look over the broad battlefield of biology, and see the vast territories which have been conquered, then relinquished in turn by mosses and fungi, pteridophytes, cone-bearing plants, endogens, apetalous and polypetalous exogens, and now are largely held by today's victors, the gamopetalous dicotyledons. We can see how the hardy pines have fought stubbornly for centuries, yielding ground only inch by inch to the endogens, the secret of whose final victory was that, Niobe-like, they protected their children though perishing themselves. We can see too how these children have been driven to the marshes, windswept plains, and cold mountain hills by the onslaughts of their more completely armed younger brothers, who, leagued with the great insect kingdom, are carrying all before them.

That will be a view well worth looking at and the sooner we begin the climb to the high ground, the better. The botany of the past is a most vital part of the botany of today. Zoölogy must join hands with us. We are dependent on each other. Distribution, genealogy, and environment will enter largely into the manuals of the future. Then the touch of nature which makes the whole world kin will be added to the long Latin names and mechanical descriptions.

[The foregoing paper was prepared at Mt Holyoke Seminary and College, S. Hadley, Mass]

Ithaca, N. Y.

F. W. Anderson, Sc. D.

F. D. KELSEY.

(WITH PORTRAIT)

This rising young botanist died in New York city on Dec. 22, 1891 from an abcess on the brain. He was especially known as an independent and indefatigable worker upon our Montana flora. Gone is he, no more to roam with me our Montana plains, no more to climb these mountains, no more to sit beside me in my study gazing through my microscope to discover Nature's secrets, no more to use his skilful pencil in catching upon paper the singular beauties of plant structure; gone while we are mutually planning for many more years of service together in our beloved science; gone, adding one more to the mysteries of divine providence which so often removes those that seem nidispensable.

F W ANDERSON

He was born at Wisbech, Eng., June 22, 1866. In 1881 the family removed to Chicago and in 1883 he came to Montana and began his brief but brilliant career in the study of the Montana flora. In 1888 he met at Great Falls, Montana, Hon. N. J. Colman, then United States Commissioner of Agriculture. At the same time also he met the then editor of the *American Agriculturist*, the Hon. Mr. Martin, who became so attached to him that the love became as a father for a son. From this time, Mr. Anderson's life was spent in Washington, at Newfield, N. J., with Mr. J. B. Ellis, or at New York at work upon the *Agriculturist*. He was beginning to publish botanical articles quite largely and venture upon revisions and description of new species.

Mr. Anderson was an example of what can be accomplished by a man of one idea. From earliest childhood he manifested a liking for scientific pursuits. For the love of botany he surrendered in later years all thought of ease, wealth or comfort. It was heaven for him to botanize; woe was it for him to be forced to do anything else.

His honored father who survives him is a clergyman, and, like all clergymen, knows what a perplexing problem it often is to make the unknown "*x*" in the yearly equation a plus quantity. Of course, his son Fred was too much of a man to allow himself to be a burden upon the struggling father. Hence he often endured poverty rather than give up his botanical investigations.

His energy was intense, and in the freedom of my intimate relationship with him I dubbed him my "night owl"; many a time forcing him to rest long before he himself would have surrendered to sleep.

The College of Montana at Deer Lodge in June, 1890, conferred upon him the degree of Doctor of Science, in acknowledgement of his valuable services in investigating the flora of our state. This was an honor of which he knew nothing until it was thrust upon him.

The agricultural department at Washington, through Mr. Galloway and Mr. Martin, put him at one time to active service at Washington where he remained until he entered the service of Mr. J. B. Ellis, the distinguished mycologist, of whom Mr. Anderson published a biographical sketch in the GAZETTE for October, 1890. He was engaged while at Newfield in making the microscopical drawings for Mr. Ellis for

his forthcoming work on the "North American Pyrenomycetes." Upon completing his work for Mr. Ellis he was engaged upon the editorial force of the *American Agriculturist* at New York. Upon taking up his permanent residence at New York, he was elected to membership in the Torrey Botanical Club whose meetings were to him a constant delight. At this time he published, jointly with myself, a pamphlet entitled: "Common and Conspicuous Algae of Montana." This was a reprint from the Bulletin of the Torrey Botanical Club.

He began his botanical publications by sending to the BOTANICAL GAZETTE short field notes and observations from Montana, and later published observations upon our Montana fungi. His articles have most of them been short and crisp, giving promise of far greater effort in the near future. He was especially skillful in drawing and was at the time of his death engaged upon drawings for Mrs. E. G. Britton's proposed work on the mosses of the northeastern United States. In Dr. Geo. Vasey's "Report of the botanist" for 1888 is incorporated a very valuable essay of fourteen octavo pages on the pastoral resources of Montana by Mr. Anderson. It does not pretend to be a complete list of forage plants in Montana, but it does describe well the usual and profitable forage of this country. He had a remarkable talent for making such a list very interesting reading even for the unprofessional. In the same report can be seen three of his drawings, viz: Plantago Patagonica, var. gnaphalioides; Lygodesmia juncea; and Solanum triflorum.

Mr. Anderson is also a valuable example of what a poor boy, without special scientific education, without instruction in a university, with a delicate and treacherous constitution, with poverty always dogging his steps, can do in a short but earnest youth.

Two things he loved with great enthusiasm, good books and botanical novelties. For the books I have seen him spend every cent he possessed; for the other no mountain was too steep, no distance too great, no weariness too distressing for him to endure, that he might lay his hands upon a new flower or grasp a new fungus. He seemed to know by instinct where to find a treasure. The inspiration of his botanical knowledge was intensified by the fact that he gained his knowledge at first hand. He knew whereof he spoke or wrote. Moreover he was a close observer of nature and a diligent collector.

His friendships were keen and constant; slow to form an affection, but once formed they were warm and enduring. He sought his friendships among the good, the diligent and the lovers of nature. By us who knew him best his loss is most keenly felt, and the botanical world is the loser not only of the talent he had exhibited, but, prospectively, of the greater things which his short career promised.

Helena, Montana.

Enumeration of the Kansas mosses.

F. RENAULD AND J. CARDOT.

Kansas, and chiefly the central part of this state, is certainly one of the regions the most destitute of mosses of any part of the United States: the atmospheric dryness, a climate extensively variable and liable to extremes of temperature and the extension of cultivated and meadow lands are the causes of the poverty of this bryological flora. For a long time it was a common belief that this land was almost entirely destitute of mosses; but it has been proved by recent researches that such is not the case, and if the moss-flora of this country is very poor in comparison with that of other states it includes, however, a relatively important number of species. The most part of these, however, grow in meagre, stunted and sterile specimens, which often makes their determination very difficult.

In 1884-85-86 Mr. Eugene A. Rau published in the *Bulletin of the Washburn College Laboratory of Natural History* four contributions to the knowledge of Kansas mosses, including a total of fifty-three species, collected chiefly by Prof. F. W. Cragin, Miss Mara Becker and Mr. Joseph Henry. The last, who died on October 12, 1887, aged more than 74 years, sent us during the year 1885 and until his death, all the species he had collected in Saline county, and by the study of this collection we are able to add nearly forty species to those previously reported by Mr. Rau.

The present catalogue includes all the mosses recorded in the four lists published by this bryologist and all those that we received from Mr. Jos. Henry. Several of these re-

main doubtful, and some specimens, too incomplete to allow any determination, have been omitted.

All the species of which we have received specimens are indicated by the affirmative mark (!); the asterisk (*) indicates those which are not recorded in Mr. Rau's contributions. The geographical names are those of counties unless otherwise noted.

*Sphagnum molle SULLIV.—Saline, a very young sterile form (*Henry*)!
*Micromitrium sp?—Too young for determination. Saline (*Henry*)!
Ephemerum spinulosum BS.— Saline (*Henry*)!
* papillosum AUST.—Saline (*Henry*)!
Phascum cuspidatum SCHREB. (?)—Saline, sterile (*Henry*)!
* var. piliferum BS.—Saline (*Henry*)!
*Microbryum Floerkeanum SCH. var. Henrici REN. & CARD. Bot. Gaz. XIV. 91. (1889). Saline (*Henry*)!
*Pleuridium Bolanderi C. MUELL.(?)—Saline, sterile (*Henry*)!
*Archidium Hallii AUST.—Saline (*Henry*)!
*Astomum crispum HPE.—Saline (*Henry*)!
* Sullivantii SCH.—Saline (*Henry*)!
Weisia viridula BRID.—City of Topeka (*Field*). Shawnee (*Becker*, *Cragin*). Wyandotte (*Bennett*). Saline, common (*Henry*)!
var. stenocarpa C. MUELL.—Verdigris valley, Wilson (*Cragin*).
Dicranella varia SCH.—City of Topeka (*Cragin*). Shawnee (*Becker*). Saline, common (*Henry*)!
heteromalla SCH.—Saline (*Henry*)! Also a sterile form, with shorter leaves; rather doubtful. Saline (*Henry*)!
Dicranum scoparium HEDW.—Labette (*Nelson*). Saline, sterile form with leaves often broken at point (*Henry*)!
*Campylopus Henrici REN. & CARD. Bot. Gaz. XIII (1888), 197 pl. XIV.—Saline, sterile (*Henry*)!
Fissidens bryoides HEDW.—Saline (*Henry*)!
* Bambergeri SCH.—Saline, sterile (*Henry*)! New to North America.
* obtusifolius WILS.—Saline, sterile (*Henry*)!
* var. Kansanus REN. & CARD. Bot. Gaz. XV (1890), 40.—Saline (*Henry*)!
osmundoides HEDW.—Brown (*Becker*).
Ceratodon purpureus BRID.—City of Topeka (*Field*). Ford (*Cragin*). Saline, a sterile form (*Henry*)!
*Pharomitrium subsessile SCH.—Saline (*Henry*)! with the young form named by Austin *P. exiguum*.
*Didymodon species nova ?—Saline (*Henry*)!
Leptotrichum pallidum HPE.—Saline, sterile form with leaves often broken at point (*Henry*)! Labette, a doubtful sterile form (*Newlon*).
vaginans SCH.—Saline (*Henry*).
*Trichostomum crispulum BRUCH.—Saline, common; several sterile forms (*Henry*)!
*Desmatodon arenaceus S & L.—Saline, sterile (*Henry*)!
* plinthobius S. & L. (?).—Saline, sterile (*Henry*)!—Owing to the absence of fructification, it is almost impossible to decide whether these specimens belong to *Desmatodon plinthobius*, or to *Barbula muralis* Timm.
Barbula Henrici RAU, Bull. of the Washb. Coll. Lab. I (1886), 172.—Saline, sterile (*Henry*)! We suspect this plant, known only in sterile state, to be referable to *Pharomitrium subsessile*.
unguiculata HEDW.—City of Topeka, Wilson (*Cragin*). Brown (*Becker*). Saline, common and very variable, but generally sterile (*Henry*)!

fallax HEDW.—Saline ,sterile (*Henry*)!
* convoluta HEDW.—Saline, sterile (*Henry*)!
caespitosa SCHW.—Wabaunsee (*Baldwin*). Saline (*Henry*).
Grimmia apocarpa HEDW.—Saline sterile (*Henry*)!
calyptrata HOOK.—Saline (*Henry*).
* leucophæa GREV.—Saline, common, but sterile (*Henry*)!
* Olneyi SULLIV. (?).—Saline, a sterile stunted form (*Henry*)!
*Hedwigia ciliata EHRH.—Saline, a sterile and very stunted form, with leaves not piliferous (*Henry*)!
*Coscinodon Wrightii SULLIV.—Saline (*Henry*)!
* Renauldi CARD. Bot. Gaz. XV (1890), 41, pl. VI, B.—Saline (*Henry*)!
Orthotrichum strangulatum BEAUV.—Saline (*Henry*)!
Pyramidula tetragona BRID.—Saline (*Henry*).
Physcomitrium pyriforme BRID.—City of Topeka (*Fields, Cragin*). Brown (*Becker*). Labette (*Newlon*).
acuminatum BS —Long Island, Phillipps county (*Hatcher.*)
* turbinatum C. MUELL.(?)—Saline, sterile (*Henry*)!
Funaria hygrometrica HEDW.—City of Topeka (*Fields, Cragin*). Labette (*Newlon*). Saline (*Henry*)!
Bartramia pomiformis HEDW.—Labette (*Newlon.*)
* radicalis BEAUV.—Saline, sterile (*Henry*)!
*Philonotis Muehlenbergii BRID.—Saline, not uncommon but sterile (*Henry*)!
marchica BRID.—Saline (*Henry*). Reported by Rau, but perhaps referable to the last.
Webera annotina SCHW.—Shawnee (*Becker*).
albicans SCH.—Brown (*Becker*). Wilson (*Cragin*). Saline, sterile (*Henry*)!
Bryum argenteum L.—City of Topeka (*Fields*). Kansas River, Shawnee, Wilson (*Cragin.*) Saline sterile (*Henry*)!
* caespiticium L.—Saline, not uncommon, but sterile (*Henry!*)
bimum SCHREB.—City of Topeka (*Cragin*), Saline (*Henry*).—Perhaps referable to the following.
* pseudotriquetrum SCHW.—Saline, common, but sterile (*Henry*)!
* Ontariense KINDB. Bull of the Torr. Bot. Club, XVI (1889), 96.—Saline, a few sterile stems (*Henry*)!
Mnium cuspidatum HEDW.—City of Topeka, common (*Fields*). Shawnee (*Becker, Cragin*). Wabaunsee (*Baldwin*). Brown (*Becker*). Labette (*Newlon*) Wyandotte (Bennett). Saline, common (*Henry*)!
affine BLAND.—Shawnee (*Cragin*). Saline (*Henry*).
* var. elatum BS.—Saline, sterile (*Henry*)!
Atrichum undulatum BEAUV.—Saline (*Henry*), reported by Rau, but probably referable to the following variety.
* var. altecristatum REN. & CARD. Bot. Gaz. XV (1890) 58.—Saline (*Henry*)!
angustatum BS.—Town of Tecumseh (*Cragin*). Shawnee (*Becker, Cragin*). Labette (*Newlon*). Wyandotte (*Bennett*). Saline (*Henry*).
* xanthopelma LESQ. & JAMES.—Saline, not uncommon (*Henry*)!
* Fabronia octoblepharis SCHW.—Saline, sterile (*Henry*)!
Thelia asprella SULLIV.—North Topeka (city), and Shawnee (*Cragin*). Brown (*Becker*).
Leskea polycarpa EHRH.—Town of Wakefield, Clay (*Cragin*). Shawnee, Brown (*Becker*). Wyandotte (*Bennett*). Saline, common, several forms (*Henry*) !
Austini SULLIV.—Saline (*Henry*)!
Anomodon rostratus SCH.—Wabaunsee (*Baldwin*). Verdigris valley, Wilson (*Cragin.*) Saline, sterile (*Henry*)!
attenuatus HARTM.—Wyandotte (*Bennett.*)
obtusifolius BS.—City of Topeka (*Fields*). Brown (*Becker*). Saline (*Henry*)!

Pylaisia intricata BS.—Jefferson (*Cragin*). Saline (*Henry*)!

*Cylindrothecium cladorrhizans SCH.—Saline (*Henry*)! with a form much resembling *C. brevisetum* by its stems and branches less compressed, and its pedicel shorter.

seductrix SULLIV.—Shawnee (*Cragin, Becker*). Wabaunsee (*Baldwin*). Brown (*Becker*).

* compressum BS —Saline (*Henry*)!

*Climacium dendroides WEB. & MOHR.—Saline sterile (*Henry*)!

*Thuidium recognitum LINDB ? Th. delicatulum LINDB. ?—Saline, sterile (*Henry*)!

Brachythecium lætum BS.—Shawnee (*Becker*). Wabaunsee (*Baldwin*). Labette (*Newlon*). Saline, sterile (*Henry*)!

* var dentatum LESQ & JAMES.—Saline, sterile (*Henry*)!

acuminatum (BEAUV).—City of Topeka (*Fields*). Shawnee, Brown (*Becker*). Wilson (*Cragin*). Saline, common, but sterile (*Henry*)!

rivulare BS. (?) —Saline (*Henry*). Wyandotte (*Bennett*).

plumosum BS. (?) —City of Topeka (*Fields*). Saline, doubtful (*Henry*.)

Eurhynchium strigosum BS.—Wabaunsee (*Baldwin*).

* praelongum BS.—Saline, sterile (*Henry*)!—Lesquereux and James, in the "Manual of the Mosses of North America," p. 353, state that "the true *Hypnum praelongum* has scarcely been found on this continent," where its place is supplied by the *H. hians* Hedw. However, all the specimens we have hitherto seen from North America are found quite identical with the European forms of *H. praelongum*, their leaves being serrulate all around, a character which does not agree with description of *H. hians*.

hians (HEDW.)—Shawnee (*Becker, Cragin*)

Rhynchostegium serrulatum (HEDW.)—City of Topeka (*Fields*) Wabaunsee (*Baldwin*). Jefferson (*Cragin*) Saline, sterile (*Henry*)!

Plagiothecium sylvaticum BS.—Saline (*Henry*)

Amblystegium serpens BS.—City of Topeka, Tecumseh (*Fields, Cragin*). Shawnee (*Becker, Cragin*). Brown (*Becker*). Jefferson (*Cragin*) Saline (*Henry*)!

* varium (BEAUV.)—Saline, common (*Henry*)!

* porphyrrhizum SCH.—Saline, (*Henry*)! Seems to be identical with *A. hygrophilum* Sch.

* adnatum (HEDW).—Saline, sterile (*Henry*)!

riparium BS.—Brown (*Becker*). Saline (*Henry*)!

var. cariosum SULLIV.—Saline (*Henry*).

* var. serratum REN. & CARD. Bot. Gaz. XIV (1889), 98.—Saline (*Henry*)!

* Kochii SCH.—Saline (*Henry*)! New to North America

Hypnum hispidulum BRID.—Shawnee (*Cragin*). Brown (*Becker*). Saline (*Henry*)!

chrysophyllum BRID.—Labette (*Newlon*). Saline, sterile (*Henry*)!

* aduncum HEDW.—Saline, sterile (*Henry*)!

Surveying the whole of this bryological florula it becomes immediately evident that the most part of the species are characteristic for the flora of the middle and eastern states. As such are chiefly to be noted: Sphagnum molle, Micromitrium ?, Ephemerum spinulosum, E. papillosum, Astomum Sullivantii, Fissidens obtusifolius, Pharomitrium subsessile, Leptotrichum vaginans, Desmatodon arenaceus, Grimmia Olneyi ?, Orthotrichum

strangulatum, Philonotis Muehlenbergii, Bryum Ontariense, Fabronia octoblepharis, Thelia asprella, Leskea Austini, Anomodon rostratus, A. attenuatus A. obtusifolius, Pylaisia intricata, Cylindrothecium cladorrhizans, C. seductrix, C. compressum, Brachythecium laetum, B. acuminatum, Rhynchostegium serrulatum, Amblystegium varium, A. adnatum, Hypnum hispidulum, H. chrysophyllum.

The following species belong to the flora of the southern states (Texas Louisiana, etc.) and reach here their extreme limit northward: Archidium Hallii, Desmatodon plinthobius ?, Barbula caespitosa, Physcomitrium turbinatum ?, Bartramia radicalis, Atrichum xanthopelma.

Grimmia calyptrata and Coscinodon Wrightii seem more especially peculiar to the flora of the Rocky Mountains. Trichostomum crispulum and Pleuridium Bolanderi ? were hitherto only recorded from California.

Monaco, and *Stenay*, *France*.

Noteworthy anatomical and physiological researches.

Ovular structure of Casuarina suberosa.[1]

In this work of Treub's we have a very good example of the sensational in plant morphology. The word is not at all to be taken in a bad sense but fitly describes the altogether unsuspected results which have followed this careful investigator's examination of a group of plants of acknowledged difficulty. After discussing the insertion of the ovules and their curious displacements which have caused much discussion (see on this Baillon, Eichler, Miquel and Engler), Treub takes up the ovular structure with the following conclusions:

1. Certain large sub-epidermal cells in the young ovule are an archesporium and develop the macrospores (embryo-sacs). They lie at the summit of the nucellus and undergo a series of tangential segmentations, finally producing a thick cylinder of sporogenous tissue which, surrounded by the tapetal layer, occupies a central position in the nucellus.

2. The cells of the sporogenous layer develop tetrads of spores, of which three become absorbed, in some cases, but in

[1]Treub: Sur les Casuarinèes et leur place dans le system natural. Ann. Jard. Buitenz. x. 145–231

others may be seen to form tracheids which are thus analogous to the elater cells of Hepaticæ The latter condition is the one observed in *Casuarina glauca* and *C. Rumphiana*.

3. Twenty macrospores are found and these elongate in the plane of the greater axis of the nucellus.

4. The micropylar ends of the macrospores develop two or three small cells which are to be considered as homologous with the canal-cells of the Eu-archegoniata and not as synergidæ. Generally only one of the macrospores has these cells endowed with a cellulose wall and this cell is the future embryo-sac.

5. The pollen tube divides, after reaching a nucellus, into at least two branches—thus reminding one of the well known phenomena in Taxus, Juniperus and Salisburia where one pollen tube is employed for the fertilization of several egg-organs.

6. A large number of endosperm nuclei are formed before the embryo is developed, thus indicating again the similarity of these cytogenetic sequences to those of the Gymnospermæ (Archispermæ).

7. Casuarina is therefore believed to occupy a decidedly anomalous position among the Metaspermæ (Angiospermæ). It is nearer to the Archispermæ than any form yet examined and may be given a place apart from the rest of the higher seed-plants. Treub proposes the following classification to admit Casuarina to its proper place, as indicated by his researches:

Archispermæ.		
Metaspermæ	Chalazagameæ ::	Casuarina.
	Porogameæ ::	Dicotyledoneæ.
		Monocotyledoneæ.

Casuarina, the only genus of its family, contains about 30 species. They are of limited range, being found principally in Australasia. A very good account of them may be found in Grisebach's *Vegetation der Erde*, and in Engler's *Natürliche Pflanzenfamilien* there is a fair figure showing their remarkable habit of growth—so similiar to that of Equisetum that they were originally classed with that genus. They are characteristic plants in the Australian forests and with their vegetative and distributional features taken into account, it is not inherently improbable that the singularly isolated position as-

cribed to them by Treub is a correct one. Their future examination is likely to be productive of much interest.—CONWAY MACMILLAN.

A contribution to the knowledge of nuclear mechanics in the sexual and other reproductive cells of plants.[2]

The paper of Guignard here noted is remarkable not only for the brilliant series of researches which it chronicles but also for the able review of a mass of literature which is not yet very well known to any except a small coterie of specialists. Reference is made to the memoirs on the subject of the intimate phenomena which are now known to go on in both plant and animal cells in process of division, and have been called the spermatokinetic and ookinetic processes. Guignard gives a résumé of the important conclusions which have been reached in both the plant and animal world and adds some luminous suggestions concerning the physical basis of heredity. A number of the facts brought forward in this paper are not altogether new, having before appeared in recent works of the same author, but the generalizations and many of the illustrative examples are not hitherto published. Guignard has been studying the development of pollen and embryo-sacs—particularly in *Lilium martagon*—and has followed out in great detail the complicated and yet altogether orderly nuclear phenomena which invariably accompany the act of reproduction and are part of its very essence. Without the aid of any very extraordinary technique or the necessity of unusually difficult manipulations he has contributed a number of extremely interesting observations along his line of work. Some of these may be briefly noted.

1. Just outside the nuclear membrane in all cells examined there are to be distinguished two small spheres of protoplasm —called by their discoverer "directive spheres." They are not easily stained by ordinary methods. These two spheres lie side by side in the resting nucleus but when the nucleus begins to divide they are seen to have a special position and function to perform. They separate and pass to opposite ends of the nucleus and form the astrocenters towards which the chromosomes slowly move and accomplish the division of

[2]Guignard: Nouv. études sur la fécondation, Ann Sci. Nat. Botan., Ser. VII. XIV. pp. 163—288.

the colorable nuclear elements. While the division is in what is commonly called the "spindle" stage the astrocenters each divide and thus form at each end of the old nucleus a *pair* of directive spheres. With the development of the nuclear membranes in the two daughter-nuclei the spheres take up their normal positions and the process may be repeated as the divisions continue. It is this contribution to our knowledge of the morphology of the astrocenter that counted so much for Guignard in the assignment of the Prix Bordin, just awarded him by the French Academy.

2. In mother-cells of spores the nuclear plate consists of twenty-four chromosomes but in the spores themselves and in sexual cells the number is only twelve. The sexual act then consists in the *addition of a number of chromosomes, that brings the number up to the normal again.*

3. These chromosomes are purely passive and their union is a function of the directive spheres which accompany them just outside the nuclear membrane which encloses the chromosomes themselves. This is brought about as follows in L. martagon—the plant of particular study:

4. After the pollen tube has reached the egg-cell, which lies in the embryo-sac immediately behind the two synergidae, the male nucleus is seen to pass over to the egg-cell and take up a position beside it in such a way that the two directive spheres are in contact with each other. The two nuclei generally lie in the same horizontal plane but in rare cases one may lie above the other. The two spheres now slip out in pairs, one pair going to what will be one pole of the now almost mature segmentation nucleus and the other pair going to what will become the other pole. As the nuclear membranes, now in close contact, dissolve, the central portions of each pair of spheres (the centrosomes) become merged and a *single directive sphere lies at each pole of the segmentation nucleus.* These become the astrocenters for the segmentation nucleus. Since the male nucleus contains more easily stained chromatin than the female, Guignard was in many cases able to tell, by examination, which chromosomes in the segmentation nucleus had come from the male plant and which from the female. He found that after the absorption of the membranes lying between the two copulating nuclei and the formation of the plate in the segmentation nucleus the male

and female chromosomes were shifted about in such a way that some of both kinds were diverted to each pole.

5. The two most important theoretical considerations noted, are, first, that the nucleus can no longer be considered as taking the initiative in the work of cell-fusion but this must be given back to the protoplasm from which the directive spheres are formed. The nuclei are but passive parcels of hereditary substance transmitted from one cell to another and always under the dynamic control of the spheres. Second, the male and female sexual cells transmit the same number of chromosomes and thus indicate that they have an equivalent part in the heredity and that the view that the male is merely a stimulant or irritant under which the female nucleus takes on the character of a segmentation nucleus is not supported by the facts of morphology in the case in hand.

The article is given a fitting close by ten of those plates which are made nowhere but in Paris. In them one can follow with the greatest ease the investigations of the author and alone they constitute no mean addition to the literature of mitosis.—CONWAY MACMILLAN.

Burnt spots on leaves.[1]

It is a well known fact, that the green parts of plants, especially the leaves, may show local or partial decolorations, due to different factors. We do not speak of the decoloration which is generally referred to chlorosis or etiolation, but of the yellow, brown or perfectly black spots which are not uncommon upon the leaves of plants kept in greenhouses. Such spots may be due to parasitic animals or plants or to inorganic agents. In the last case they are characterized as "burnt spots." This disease has been recorded in literature long ago. Burnt spots have been attributed to several pathological changes, which, although they showed great similarity to those caused by a relatively high temperature, nevertheless originated from quite different factors.

One of the oldest theories to account for these, and as it seems the only acceptable one, was that which ascribed them to the common presence of air-bubbles in the glass used as cover for green-houses. The air-bubbles were supposed to have

[1] JŒNSSON BENGT: Om brænnflæckar paa væxtblad. Botaniska Notiser. Lund 1891, 30 pp. 2 colored plates.

the effect of lenses, by which the sunlight became concentrated and thereby caused a burning of the exposed parts of the leaves. Another theory, quite generally adopted, was that drops of water left on the leaves after they had been watered, might have the same effect as lenses or by their own heat be able to burn the leaves, especially in houses without sufficient ventilation.

De Candolle suggested that the burning might be caused by the drops of water, which at once softened the tissue of the leaves, became heated in the sunlight and thereby prevented evaporation. In *Gardener's Chronicle* for 1858 burnt spots on orchids were said to originate from too much moisture in connection with too low temperature.

The explanation most commonly adopted, however, is that which attributes the effect to drops of water having been heated by the sunlight and it has been so recorded in the more prominent phytopathological manuals. Sorauer for instance in his *Pflanzenkrankheiten* explains the fact quite briefly by this statement. Neumann[1] came to the same conclusion by some experiments he made with *Cordyline*. On the other hand he observed that if the leaves were fastened in a certain position they were burnt even if there was sufficient draught. Another author, who has almost adopted the same theory, is Frank[2], although he does not exclude the possibility that the drops of water might also be able to act as lenses. And he found support in Hoffmann who was the first to show, by experiments on grapes, that drops of water in a hanging position are able to concentrate the sunlight and to produce burning. Later von Thümen[4] expressed full accordance with Hoffmann. But the old theory, that the burnt spots were caused by air-bubbles in the glass, seems to have been entirely abandoned, although Neumann (l. c.) was not quite unaware of the possibility of its correctness; he did not believe, however, that such air-bubbles could burn except through very short distances.

The author of the present paper calls attention to the fact that the true burnt-spots are easily distinguished by their

---

[1] Adansonia, Vol. II, 1862, p. 312.

[2] Die Krankheiten der Pflanzen, 1880, p. 174.

[3] Samenbruch bei der Weinbeere, Botan. Zeitung 1872, p. 113.

[4] Ueber den Sonnenbrand der Rebenblætter, Die Weinlaube 1886, p. 409.

most frequently elliptical form with the longest diameter often from east to west, and if they occur several together on one leaf, they form always longitudinal rows from east to west, the spots in the middle being the largest. He has made a series of experiments so as to test the different theories, which have been enumerated above. It has been thereby proved, that drops of water are unable to cause any kind of burning by their own heat. Further, as shown by Sachs, the vegetative cell of land-plants is able to stand a heat of 51° C. All the experiments, made by the author in that direction, gave negative results, so that Neumann's theory cannot be correct. Some experiments were made with water of a temperature above 60° C., but even this did not affect the leaves.

As regards the supposition, that drops of water might have the same effect as lenses, it is quite clear that drops which have fallen on leaves merely represent half-lenses, a fact to which already De Candolle has called attention. And it is shown by experiments, that only when the drops of water were out of contact with the leaves, do they become able to cause a kind of burning, for instance when hanging down from the inside of a glass cover.

The author has come to the conclusion that in most cases the burnt spots are due to the poor quality of the covering glass, by the air bubbles of which the sunlight becomes concentrated so as to produce a burning on the leaves.—THEO. HOLM.

BRIEFER ARTICLES.

Cleistogamy in the genus Polygonum.—On page 273, vol. XVI, BOTANICAL GAZETTE, it is noted that "Mr. Thomas Meehan has found cleistogamous flowers in abundance on *Polygonum acre* and suspects the same habit in other species." On page 314 of the same volume of the GAZETTE, Mr. T. H. Kearney, Jr., records his observation of cleistogamous flowers upon *Polygonum acre* at Knoxville, Tenn., accompanying his note with figures. Mr. Kearney farther states that he has "searched for cleistogamic flowers on other species of Polygonum without success."

I am led by the appearance of these notes to state that in my studies of the genus Polygonum, I have found cleistogamous flowers

on many species, thus verifying the thought of Mr. Meehan. From an examination of my preliminary notes upon the genus, verified by a reëxamination of the specimens, I report the finding of cleistogamous flowers upon the following species: *P. arifolium*, in which the achenes in my specimens were incompletely developed; *P. Bolanderi, P. Californicum, P. Careyi, P. Hartwrightii, P. Hydropiper*, the condition being extremely common in this species; *P. hydropiperoides*, in which in every case examined the achenes were perfected; *P. lapathifolium, P. maritimum, P. ramosissimum*, in which case, however, I am not thoroughly convinced as to the cleistogamous character of the flowers so referred; *P. sagittatum*, and *P. Persicaria*. I found that in almost every case in which I had *late* collections of the species mentioned above, cleistogamous flowers existed. That more species are not included in the list is, I am inclined to believe, due to the fact that the specimens of the other forms in my possession were collected in the earlier portion of their season. I believe that in all cases where collections are made after Sept. 15th, cleistogamous flowers may be reasonably expected.

The figures given by Mr. Kearney in the note referred to above present an exceptional condition. In the many forms which I have examined it only occurs once or twice. Ordinarily the cleistogamous flowers are completely concealed by the sheath, but if well developed their presence may be detected by the appearance of an apparent intumescence of the sheath on one side of the stem and slightly above the node. Occasionally when the sheath is short the tip of the flower may be seen projecting a little beyond its border. In the ordinary herbarium specimen, unless care is taken in the dissection, the flower will be taken for a fragment of the sheath, unless indeed the achene be well developed. I have as yet detected only a single flower at each node, but am not prepared to say that this is the rule.

In this connection I would like to ask botanists throughout the country to send me any notes they may have upon the genus, and to state that I would be glad to receive specimens for examination from such as are willing to spare them for a sufficient time for their proper study.—STANLEY COULTER, *Purdue University, La Fayette, Ind.*

Cultivating the ascosporous form of yeast.—The methods usually recommended for securing the ascosporous state of yeast, i. e. by cultivation upon slices of potato or other vegetables, or even upon plaster of Paris slabs, have always ended in failure in my laboratory, until a recent trial by the method suggested by Hansen.[1] This method con-

[1] Les ascospores chez le genre Saccharomyces. Comp. rend. trav. du lab. de Carlsberg, ii, p. 30; also see Zopf, Die Pilze, p. 414.

sists essentially of securing particularly vigorous, actively growing yeast plants, which are transferred directly to moist slabs of plaster of Paris, on which they develop the spores very rapidly. The sudden change from the condition with abundance of nutriment to one with almost total absence of it, appears to call out the extreme reproductive safeguard of the species against annihilation.

Hansen advocates starting with pure cultures, from which some cells of yeast are transferred to beerwort for a short time at common room temperature, then a small quantity of the active cells is again removed to fresh beerwort for 24 hours at a temperature of 26–27° C. A supply of the cells thus obtained is sown upon sterilized blocks of plaster of Paris, which are made sufficiently moist to slightly glisten, and are afterward kept in a moist chamber at proper temperature.

The method followed in my laboratory was to add a little yeast, taken from a fresh cake of Fleischmann's compressed yeast, to a Pasteur solution. In a day or two, when the disengagement of gas showed that the yeast was in active growth, the liquid was poured out of the flask, some of the flocculent material adhering to the glass was spread upon the surface of a freshly made cake of plaster of Paris, which was barely moist, and the whole was covered to prevent drying out. The cakes were made by stirring water into powdered plaster of Paris and allowing it to harden in a shallow covered dish. In a few days a most abundant crop of ascospores was obtained. The spores are easily colored with methyl violet; and fine permanent mounts may be made by the coverglass method as used for bacteria.

The work was carried out by Messrs. Wright and Van Pelt of the present senior class.—J. C. ARTHUR, *Purdue University, La Fayette, Ind.*

EDITORIAL.

THERE IS a wide field for American ingenuity in devising new adaptations of apparatus used in other departments, and in inventing new forms of apparatus, with which to illustrate the main truths of vegetable physiology. Much work of this kind must be done before the science can be so generally taught in high schools and colleges as its position as a fundamental science demands. Special forms of apparatus will naturally be brought out to meet the requirements of investigators working in original lines, which will enrich the available supply, but new methods of making old truths clear by means of

simple yet well constructed apparatus, are needed in all present laboratories. Not only do we need new kinds of apparatus, but it is also a matter of moment to know where both the old and new forms can be purchased at a reasonable price and without too great delay. At the present pedagogical stage of the science it is possible to buy only a few pieces that the books describe, and those must largely be imported at a cost that in some cases effectively excludes them from many laboratories. The annoyance of determining proportions, making drawings and carefully describing the required pieces in order to have them made to order, even for glassware, is too laborious and time-consuming to permit of doing much of it. At present many teachers are driven to making their own apparatus as best they can, which as a rule is not an economic expenditure of the teacher's time or of the institution's funds. Until the facilities for purchase, which now obtain for microscopical, physical, chemical and other kinds of apparatus, also embrace physiological pieces, laboratories will not multiply, and the science be taught with the completeness that its importance demands.

***

BOTANISTS, particularly those of the upper Mississippi valley, have been watching with considerable interest the formation of the faculty of the new Chicago University. Hopes have been raised, as we noted the high scholarship and particularly the high degree of specialization of the men that were being appointed, that the chair of botany would be filled with some specialist of repute, and that thus the new institution would set the pace for some of the older ones that have shown themselves laggards.

BUT WE CONFESS that it was with a feeling of sore disappointment that we read in the Chicago papers of the appointment of a professor of "biology." Apparently it is to be the old story of zoölogy masquerading in borrowed plumage as biology, for the gentleman who has has been appointed is a well-known zoölogist. As to his qualifications on the botanical side we know nothing, but we do know that no one man can teach biology properly in such an institution as the Chicago University bids fair to be. It would be a difficult feat for one man to teach zoölogy alone or botany alone, as it should be taught; to ask him to teach both, savors too much of the time when a man could be "professor of natural science."

IT IS SINCERELY to be hoped that President Harper will see to it that he chair of biology is divided before zoölogy teaching comes to stand for biology in the institution from which we expect so much. If this

is not done we shall not be surprised to have an early announcement similar to that in the December number of the *American Naturalist*, in which appears the naive item — we are sure our readers will appreciate its fine humor — "Prof. C. H. Gilbert is professor of *Vertebrate Biology* in Leland Stanford University."

IN THIS CONNECTION we are much pleased to note the establishment of a new chair of histology and cryptogamic botany at Cornell University. This is a move in the right direction.

CURRENT LITERATURE.

Kuntze's "Revisio Generum Plantarum."[1]

This is one of the most ambitious botanical works of recent years, and has involved a prodigious amount of labor. However botanists may differ as to its conclusions, they must always be grateful for the vast amount of facts thus brought together. It is becoming more and more apparent that the nomenclaturists are not to agree with each other, at least until another congress has definitely established a datum line. In the meantime the systematist who is not a nomenclaturist feels inclined to reserve his opinion until the dust has settled somewhat and things can be seen more clearly. When all the ancient records have been searched, and books like those before us have become numerously multiplied, and confusion worse confounded reigns, some one will begin to bring order out of chaos, stability out of upheavals. There is no desire here to criticize the efforts of nomenclaturists, of whom Dr. Kuntze seems to be the bright consummate flower, but to emphasize the fact that we are still in the period of "stirring up," not of "settling." Devoid of all principles, sound or otherwise, we hold ourselves in readiness to accept and use any name which gives promise of a reasonable tenure of life.

The GAZETTE has often given, and still maintains the opinion that the necessary changes in nomenclature should never be attempted in this wholesale fashion, but that they should be made by monographers, who have an abundance of material before them and know whereof they speak.

The volumes before us are such as will demand consultation by all those who deal in phytography. The wealth of reference is marvel-

[1] KUNTZE, OTTO.— Revisio Generum Plantarum vascularium omnium atque cellularium multarum secundum leges nomenclaturæ internationales cum enumeratione plantarum exoticarum in itinere mundi collectarum. 2 vols. 8 vo. pp. clxvix, 1011. Leipzig, London, Milan, Paris, New York (Gust. E. Stechert, 828 Broadway), 1891.

lous, while dates of genera and important works will furnish a mine of information to all systematists who do not have access to the extensive literature to be found at London and Berlin. The author seems to have caused most confusion by taking up the generic names of the first edition of Linnæus, Systema, instead of the first edition of his "Genera Plantarum." To illustrate, it may be imagined what confusion will arise in changing Nasturtium to Cardamine, Arabis to Erysimum, Lepidium to Nasturtium, and Sisymbrium to Hesperis. Upon the flimsiest pretext for example, Tragacantha replaces Astragalus, and its nearly 1500 species are renamed. To mention all the suggested changes, or even the startling ones, that have to do with North American plants would be impossible in the space at our command, but in this connection we are glad to call attention to the excellent service rendered by our friend, Dr. Britton, in printing in the February *Bulletin* the principal changes suggested for the generic names of North American plants, a service rendered still more valuable by his own annotations.

The plant world.[1]

Under this title Mr. Massee has published what appear to be lectures originally prepared for use under the auspices of the London Society for the extension of university teaching, to which society Mr. Massee is a lecturer. These lectures deal with plant architecture; the chemistry and physics of plant life; protective arrangements; reproduction in plants; relationship amongst plants; fossil plants; and the geographical distribution of plants.

Mr. Massee is a botanist of no mean repute, and one expects more of him than of an unknown tyro. The ground covered by this little book embraces some of the most interesting portions of the science. We wish that we could say that it is a readable book. It has very much in it to which no exceptions could be taken; much that is interesting and well put. But it is exceedingly uneven. In the main it is accurate, though not infrequently the writer's meaning is obscure because of his faulty English. This is the more remarkable by reason of the general clearness of Mr. Massee's scientific papers. On the side of fact the histological part of the chapter on plant architecture is perhaps the worst, and this also is marked by the poorest illustrations.

As a whole the style is very bad. The sentences are long and involved. Occasionally they extend to enormous lengths. We note one

---

[1] MASSEE, GEORGE :— The plant world, its past, present and future; an introduction to the study of botany. 12 mo., pp. x. 212, figs. 56. London: Whittaker & Co. (New York: Macillman & Co.) 1891. 3*sh*. 6*d*.

on pages 82 and 83 which is over a page long and contains 339 words, equalling about three-fourths of a page of the GAZETTE. Those covering half a page are frequent. These long sentences seem to be constructed on the same principle as the mnemonic word-chains; the thing with which the writer began reminded him of something, that of something else, and so on until by the time the period is reached one finds that he is talking of something rather remote from that with which he began. Here is a sentence which sadly needs mending: "It must be understood that potassium is not the only factor necessary for the formation of starch; but if this substance is absent, even if all other conditions are favorable, as in the case of iron and chlorophyll so also with starch which contains no potassium, the latter being necessary for promoting the chemical changes resulting in the formation of starch." p. 56.

We fear also that Mr. Massee's generalizations will be found much too sweeping. The voice is the voice of Massee, but the reasoning is the reasoning of Grant Allen. It is taking, but it is not sound.

Making a charitable guess we should say that Mr. Massee had been persuaded to allow his lectures to be printed without having or taking sufficient time to revise them properly. If these popular books were to be read only by specialists there would be little mischief in erroneous or faulty statements. But no book demands so much of an author as one that is prepared for readers who are not able to separate the wheat from the chaff. This book needs a little winnowing, and the grains of truth should be thoroughly brushed before they go through the mill of the "general reader."

Minor Notices.

THE VERY INTERESTING address of Dr. George L. Goodale as retiring president of the A. A. A. S. on the useful plants of the future, and some of the possibilities of economic botany, has been distributed in reprints from the *Proceedings* of the association.

THE MALTREATMENT of our shade trees and the diseases which are likely to follow the mechanical injuries which are inflicted upon them by thoughtless drivers, ignorant trimmers and ruthless linemen, formed the subject of an address before the Massachusetts Horticultural Society by Dr. W. G. Farlow, which has recently been reprinted from the *Proceedings* of the society. The society was urged to make an effort to secure legislation which should make compulsory the placing of guards around trees and the entrusting of the care of trees in public grounds only to persons specially trained for the purpose. The GAZETTE would bid such efforts God-speed.

IN CONNECTION with the paper of the series on flowers and insects published in this number from the pen of Mr. Charles Robertson, it may be well to call the attention of all our readers who are interested in these topics, to the paper of the same series printed in the *Transactions* of the St. Louis Academy of Science, vol. v, p. 569. The orders therein treated are the Asclepiadaceæ to Scrophulariaceæ.

IN A RECENT bulletin, notable as being no. 1 of the division of vegetable pathology, Dr. Erwin F. Smith adduces additional evidence of the communicability of peach yellows and peach rosette. The latter disease has been considered a form of the yellows, but Dr. Smith has recently described it as a different disease. It is spreading in the archean region of Georgia, and is more virulent than the yellows. Extermination of diseased trees is the only measure that can be suggested at present.

MR. JOHN ROBINSON published in the *Salem Gazette*, during the summer of 1891, a series of articles upon the trees of Salem and vicinity. These papers have since been revised, and now appear in pamphlet form issued by the Essex Institute. They were written for popular entertainment and instruction, but in Mr. Robinson's hands they have been made full of interest to botanists as well.

DR. GEORGE VASEY'S "Grasses of the Southwest," Part II, completing the first volume, has been distributed, and fully sustains the excellent character of Part I. Fifty species are illustrated by most excellent full page plates, and facing each plate is the descriptive text. We could have wished that with every description a full statement of the range of the species could have been given. The trimming of the leaves also has made binding difficult, for any further reduction will cut into the titles of plates or the figures themselves.

"THE GENUS POLYGALA IN North America," by Wm. E. Wheelock, is the title of the fourth and last number of Volume II of the "Memoirs of the Torrey Botanical Club." Mr. Wheelock has studied the specimens found in the largest American herbaria and Dr. Britton has examined most of the types preserved in Europe. The species number 38, and of these very full descriptions, synonymy, and range are given. A new species from Texas (*P. Tweedyi* Britton,) is described, and some new varieties proposed. *P. fastigiata* Nutt. (1818) is *P. Mariana* Mill. (1768); and *P. viridescens* L. replaces *P. sanguinea* L. of same date. The error of date under *P. Rugelii* had better be corrected. It should read Shuttleworth, Chapm. BOTANICAL GAZETTE, iii. 4 (Jan. 1878).

PROFESSOR GREENE'S *Flora Franciscana*, Part II, continues that important work through 24 additional orders. The succession of families

is interesting to those only familiar with the ordinary sequence. The intercalation of Apetalæ among Polypetalæ has long been a much desired change, and it is a good thing to have it put in this concrete way and applied to our North American plants. The changes in generic and specific nomenclature are mostly such as Professor Greene has already indicated in previous papers.

OPEN LETTERS.

The new herbarium pest.

In reference to the article in the December number, 1891, by Prof. C. V. Riley on the "New Herbarium Pest," let me add my experience. Today in looking over duplicates four of the geometrid larvæ were found on Aphyllon Ludovicianum collected in this county in June, 1890. A few drops of a pretty strong solution of corrosive sublimate and arsenic in diluted alcohol were dropped on each. During an examination of the plants for more larvæ or eggs, in about twenty minutes, the liquid had evaporated, and the paper being again dry, I observed to my dismay the little surveyors stretch and move again, slowly at first, but in about five minutes as actively as before their bath. They are now bottled for observations. This extraordinary tenacity of life increases the formidability of this pest.—DR. H. E. HASSE, *Santa Monica, Calif.*

NOTES AND NEWS.

THE STATE OF KANSAS is spending $3500 in spreading the entomophthoral disease of chinch bugs under the direction of Professor F. H. Snow.

PROFESSOR W. C. WILLIAMSON, until recently at Owen's College, Manchester, has changed his residence to 43 Elms Road, Clapham Common, London.

DR. SERENO WATSON died March 9th, at his home in Cambridge, Mass., after a prolonged illness resulting from an attack of "la grippe." No tidings since the death of Dr. Gray will cause botanists profounder sorrow than this.

DR. THOMAS TAYLOR, the United States microscopist, is said to be preparing models of fungi for the Columbian Exposition, to include all the edible varieties of the United States.

THE DECEMBER NUMBER of the *Microscopical Bulletin* contains a very fine photogravure of Bacillus tuberculosis made from a photograph taken with Queen's 1-15 homogeneous immersion lens.

THE UNIVERSITY EXTENSION work of the State University of Iowa embraces twelve lectures on "world-making," four of which are devoted to plants. The botanical lectures are given by Professor T. H. McBride.

Mrs. W. A. Kellerman has been writing very pleasantly about leaf variations, which she has observed from time to time. Several of her articles have appeared in *Science*, in the issues for Jan. 29, Feb. 12, and others.

The herbarium of the University of Minnesota contains about 42,000 plants, including 15,000 spermaphytes. It embraces sets of exsiccati by Ellis, Thümen, Sydow, Roumeguère, Krieger, Rehm, and some others, in the fungi.

Twenty-three Californian weed seeds are illustrated and described by Mr. Hubert P. Dyer in the annual report of the California Experiment Station for 1890, recently issued. The article is part of a graduating thesis.

A certified list of exchanging botanists, classified according to their ability and usual practice in the preparation of herbarium specimens, is being compiled by Mr. J. A. Morton, secretary of the Canadian botanists' correspondence association.

The source of infection for wheat rust is discussed by Professor H.L. Bolley in *Agricultural Science* for last December. He concludes that the uredospores are the chief generators of the rust, and that the wind may carry them very long distances, even hundreds of miles.

A revision of the North American species of Xyris, by Heinrich Ries, is published in the *Bulletin* of the Torrey Botanical Club (Feb.). Fourteen species are described (one new) and their range and synonymy given.

Prof. E. B. Knerr, of Midland College, Atchison, Kansas, will furnish fresh rooted specimens of *Erythronium mesochoreum* Knerr this spring to all who desire them, provided they send ten cents (to cover postage and packing) with their addresses. The plant usually begins to bloom shortly after April 1st.

Mr. Harold Wager of Leeds claims to have demonstrated the presence of a nuclear structure in a species of Bacillus which forms a thin scum on water containing Spirogyra in a state of decay. These researches combined with earlier ones leave little doubt of the presence of a nucleus at least in the more highly organized microbes.

Since the appearance of Kuntze's *Revisio Generum Plantarum* Dr. John Briquet, who is elaborating the Labiatæ for Engler and Prantl's *Natürliche Pflanzenfamilien*, has examined the changes proposed by K. in the generic names of this order. Out of the fifteen suggested he considers five well founded.[1]

Mr. R. E. Fry finds in certain cells of the stem of Euphorbia splendens aggregations of proteid which are "used as a reserve nitrogenous material, answering to starch among carbo-hydrates." Other species of Euphorbia and allied plants do not exhibit aggregations of such material.[2]

---

[1] Bot. Centralb. xlix. 106.

[2] Annals of Botany v. 413.

THE OUTLINES of a university extension course of six lectures on the physiology of plants, which is being given at Tomah and Appleton, Wis., by Dr. Charles R. Barnes, have been distributed. The topics of the lectures are as follows: "How plants forage; How plants eat; How plants breathe; How plants grow; How plants move; How plants multiply."

PROFESSOR J. E. HUMPHREY has given in the *American Naturalist* (Dec.), under the title "The comparative morphology of the fungi," a very useful outline view of the conclusions contained in the last four parts of Brefeld's "Untersuchungen aus dem Gesammtgebiete der Mykologie;" views with which not merely every mycologist should be familiar, but every student of botany.

A LEARNED, interesting and suggestive lecture by Mr. Charles F. Cox of New York city, on the question, "What is a diatom?" is given in the January number of the *Journal of the New York Microscopical Society*. It not only answers the question from the technical and biological sides, but presents a strong plea for the toleration and encouragement of the study of pure science, based upon the history of the development of knowledge as influenced by the study of these organisms.

IN THE ANNUAL REPORT of the President of Harvard College, for 1890–91, it is stated that during the year the total number of specimens received by the Herbarium was about 13,000, and the number mounted and distributed 10,995. The total expenditure of the Herbarium was $6329.84, against $3048.60 in 1889–90, and $4493.23 in 1888–89. The additional expenditure of 1890–91 was made possible by the gift of $3500 a year for five years. This gift was made in the hope that it would ensure the completion of the Synoptical Flora.

IN BULLETIN 37 of the Cornell Experiment Station Professor Bailey gives a lucid account of the three species of Physalis which have come into cultivation as fruit-bearing plants, viz., P. pubescens, P. Peruviana and P. capsicifolia.— Prof. Bailey thinks that if some way can be found to make the pepino (Solanum muricatum), a very interesting plant of recent introduction, set fruit more freely in the north it promises to be an acquisition for the kitchen-garden and for market. — He recommends the chorogi (Stachys Sieboldi), the new tuberiferous labiate, for trial in every home garden.

SOME YEARS AGO Van Tieghem demonstrated the existence of invertase in pollen, a ferment which converts cane sugar into glucose. Experiments carried on by Mr. J. R. Green demonstrate the presence of diastase in the pollen of a number of common cultivated plants. Fresh pollen ground up between glass plates and mixed with a thin starch paste produced the usual disappearance of starch and formation of glucose. The ferment acts also when extracted by the glycerine method.[1]

PROFESSOR L. H. BAILEY in an admirable account[2] of the dewberries, shows that they arise from two species of Rubus, R. Canadensis and R. trivialis, of which the former also shows two well marked

[1] Annals of Botany v. 512.

[2] Cornell University Exper. Station, bulletin 34.

varieties, roribaccus and invisus. He calls attention again to the fact that the bush blackberry does not have any trailing forms, the so-called var. humifusus having apparently been established upon a dewberry. Apropos of this bulletin we may be permitted to remark that we know of no better model for experiment station botanists than the recent bulletins of the horticultural division of the experiment station of Cornell University.

AMONG THE BULLETINS of the experiment stations recently received are quite a number upon botanical topics. Dr. C. F. Millspaugh (W. Va., No. 19) writes on weeds, especially their value as fertilizers for the soil when suitably composted. Prof. L. H. Pammel (Iowa, No. 15) gives a very full account of the fungous diseases of the sugar beet, more particularly those caused by species of Uromyces, Cystopus, Cercospora and Rhizoctonia. Fungicides and their specific application are treated by Miss Freda Detmers and Mr. W. J. Green (Ohio, vol. IV, No. 9), Mr. E. G. Lodeman (Cornell, No. 35) and Mr. L. F. Kinney (R. I., No. 14).

THE FOLLOWING tribute is paid to Dr. Geo. L. Goodale in the last annual report of Harvard University: "The development of the botanical establishment of the University during the last ten years may fairly be called extraordinary. It has acquired a large fire-proof museum, to contain not only its collections, but its lecture-rooms and laboratories; has added greatly to its collections and its library; and, at the same time, has obtained larger permanent funds for the support of the combined establishment. Every branch of the work has been developed and enriched. For all this material progress the University is chiefly indebted to Professor George L. Goodale, Director of the Botanic Garden."

TWO NUMBERS of the new *Forstlich-naturwissenschaftliche Zeitschrift* have reached us. In typography they are somewhat disappointing, since they are printed in German type instead of Roman, a step which the majority of scientific men will consider retrogressive, no matter to what nation they belong. The contents of the two numbers is as follows: Dr. Robert Hartig, The sickening and death of pines on account of defoliation by Liparis monacha; Dr. Carl von Tubeuf, The diseases of Liparis monacha; Dr. R. Weber, On the influence of seed production upon the ash constituents and nitrogenous reserve materials of the wood of the red beech; Dr. A. Pauly, On a breeding research with Pissodes notatus; W. Eichhoff, Suggestions as the extermination of insects injurious to forests and field-crops.

MR. SPENCER LEM. MOORE shows [1] that the callus with which sieve plates of the vegetable marrow are closed at the end of the growing season is formed of proteids. The slowness with which some of the proteid reactions take place have caused observers to deny their occurrence. The behavior of the callus with neutral salt solutions and other solvents is like that of coagulated proteids. They can be removed from the sieve-plates by a peptonizing fluid, and in nature their mode of removal strongly suggests the action of a proteolytic ferment, which however has not been isolated. Mr. Moore also finds that the so-

[1] Journal of the Linnean Society xxvii. 501.

called "stoppers" of the cells in the thallus of Ballia callitricha have similar reactions to the proteid tests, except that they do not dissolve under the action of a peptonizing ferment. He considers them of proteid nature, allied to lardacein.

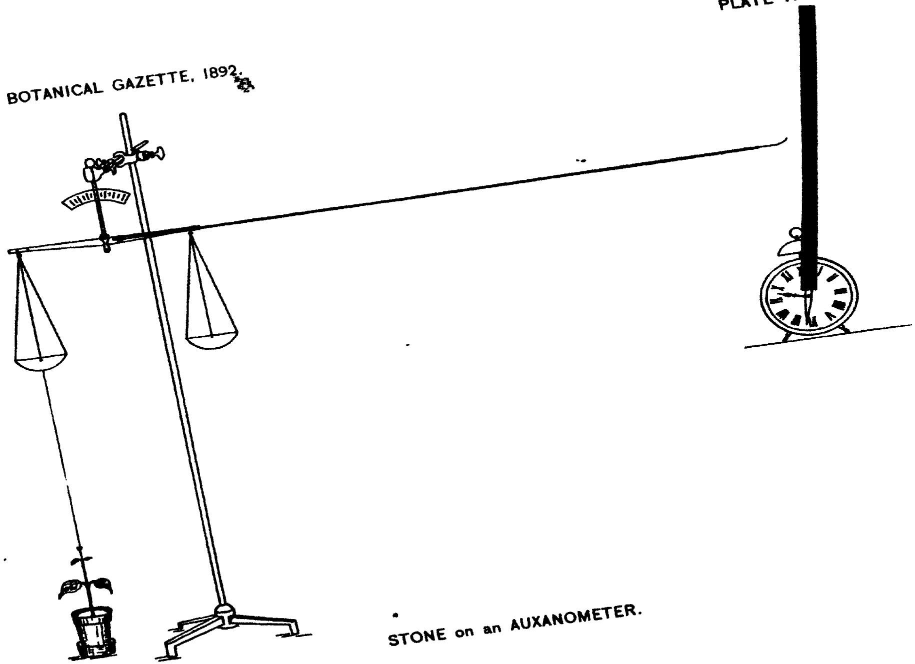
AT A RECENT meeting of the Linnean Society (Jan. 21), Mr. F. E. Weiss read a paper "On the development of the caoutchouc-containing cells of *Eucommia ulmoides*." He found that the bark and leaves of this tree, used medicinally by the Chinese, and called by them "Tu-chung," contain numerous elastic threads of silky appearance, which proved to be of the nature of caoutchouc. They are contained in long unbranching cells, somewhat like latex cells, which are found in the cortex and in the secondary phloem, and accompany in large numbers the ramifying bundles of the leaf and the pericarp. Unlike the ordinary latex cells, they are not derived from specialized cells of the embryo, but originate in all new growths, and can be seen forming in the cortex, the pith and the parenchyma surrounding the bundle of the petiole. They originate in twos, by longitudinal division of a very granular cell, both daughter cells growing out at their two extremities into a long tube, which makes its way along the intercellular spaces by sliding growth. They never contain more than one nucleus, and the large granules of caoutchouc, which soon make their appearance, finally coalesce into a single mass, which has, when the tissues are broken, the appearance of a silky thread. Mr. Weiss regards these cells as a primitive form of latex cells, similar to those from which the more elaborate ones of the ordinary Euphorbiaceæ may have been derived.— *Gard. Chron.*, Feb. 6.

A CONTRIBUTION to the detection and function of tannin is made by Moore in the seventh paper of his series: Studies in vegetable biology.[1] The summary is here reprinted:

1. Nessler's test for ammonia is a valuable aid to the botanist in detecting with certainty and rapidity the presence of tannin and tannic acids in plants. Other fluids having caustic potash for a basis are also good reagents for tannin. 2. Two chief kinds of tannin are to be distinguished according to their behavior with Nessler's fluid: (a) the iron-blueing tannin strikes brown with the fluid; (b) the iron-greening variety is turned yellow by it. 3. The yellow substance just mentioned readily diffuses through the cell wall; this effect is to be ascribed to the caustic potash, for alkaline solutions, even the weakest, will act in the same way. Here we have a provision, by the aid of rain, dew, and activity of soil organisms, for the excretion of tannin from the general surface of plants containing this form of it. 4. In addition to the functions hitherto ascribed to tannin, Haberlandt's recent discovery, with reference to the water-drop exuding on section of Mimosa pudica, renders it probable that tannic acid may have a more general relation to the turgescence of cells. Moreover, tannin is most likely used up in the lignification of the cell wall. 5. The diffusible tannin, although primarily excretory, and the non-diffusible kind when occurring in shed organs, may yet, in view of the fact that tannin can act as a source of carbon to fungi, have some indirect connection, *via* the nutrition of saprophytes, with the metabolism of green plants.

[1] Journal of the Linnean Society xxvii. 527.

THE HOMOLOGIES of the angiospermous embryo-sac and its contents always form an interesting subject for speculation. The prevalent view at present, that the embryo-sac is a macrospore and its contents a 7 or 8-celled prothallium, is not without objection; not a small one being that it in no way accounts for the conjugation of a micropylar and an antipodal nucleus to form what is known as the definitive nucleus. The formation of an 8-celled prothallium by nuclear division is perfectly clear; but the conjugation of two of these nucli is in no way explained by the ordinary view. Warming and Vesque consider that the eight nuclei produced within the embryo-sac represent two sets of four macrospores derived from two sporocytes, the embryo-sac thus becoming a special spore-mother-cell. Marshall Ward has advanced the view that the eight nuclei correspond to two 4-celled prothallia. Gustav Mann, however, in the Proc. Roy. Bot. Soc. of Edinburgh (June, 1891), who has been investigating the whole subject as exemplified by *Myosurus minimus*, has a hypothesis to suggest, which, so far as we know, is the first that has attempted to explain the double conjugation which takes place in the embryo-sac. He believes that the micropylar half of the embryo-sac corresponds to four female spores or macrospores; and the antipodal half to four male spores or microspores. Two of these eight cells conjugate, giving rise to the endosperm-cell, which must be looked upon as producing a true embryo, but which being weaker than the embryo resulting from cross-fertilization (of oosphere and pollen-nucleus), has become modified to serve as a storehouse for the stronger embryo. Such a theory would also play its part in suggesting explanations of apparent parthenogenesis and polyembryony. There is no doubt but that our views of the homologies of these parts must be modified; whether they will take the direction so ingeniously suggested by Mr. Mann is another matter.



STONE on an AUXANOMETER.

BOTANICAL GAZETTE

APRIL, 1892.

A simple self-registering auxanometer.

GEO. E. STONE.

(WITH PLATE V)

The various forms of self-registering auxanometers used in botanical laboratories are more or less complicated and costly instruments. Such instruments as are used by Sachs, Wiesner, Baranetzky, Pfeffer, and others, vary considerably in their construction and utility. One of the best auxanometers for general purposes that has been devised is that of Baranetzky. A modified form of this apparatus is used by Pfeffer, a figure and description of which is given in his Pflanzenphysiologie.[1]

The multiplying apparatus, which, however, is the most important part of an auxanometer, consists of two grooved wheels of different radii that are fixed to a horizontal axis which revolves on delicate bearings. The large wheel has a radius of 100 mm., and the small one of usually about 12.5 mm., thus giving an enlargement of eight times; over the small wheel there passes a thread, one end of which is connected with the plant, the other to a weight of sufficient size to cause the wheel to respond freely to the movements of the plant. Each movement of the small wheel is communicated to the large wheel which supports the pen and a compensating weight. This apparatus can be used with any form of a registering cylinder; perhaps the most convenient for general purposes is the electric drum that registers in steps.

The accompanying figure shows a simple and inexpensive auxanometer used by the writer, which can be easily constructed by any one. The enlarging apparatus consists of a hand balance, such as is used in every laboratory. The arrangement is as follows: To one of the balance arms there is attached a very light though rigid straw, to the free end of the straw there is fastened, by means of sealing wax, a fine pin of spring brass

[1] See also Goodale's Physiological Botany, p. 383.

wire that serves as a pen. The end of the wire or pen is hammered out very thin, and cut with a pair of scissors to a delicate point. A length of one or two cm. near the base is also flattened to lessen the rigidity of the wire, that the point may offer much less resistance when in contact with the cylinder. It is necessary that the pen should be long and sufficiently curved, so that the straw itself does not come in contact with the cylinder.

To the other balance arm the plant is connected by means of a thread fastened to the under side of the scale. Before attaching the plant, however, enough weight is added to the left hand scale to balance the weight of the straw, after which a small weight (in our experiments .04 gm.) is added to the right hand scale to produce the proper deflection, which should be equal to at least one-half the length of the registering cylinder. The amount of deflection can be determined by a paper protractor fastened at the top of the balance. If now we have a deflection equal to one-half the length of the registering cylinder, and the balance arm be placed at a corresponding point above the horizontal position, the pen will have an amplitude of motion equal to the whole length of the cylinder. When the balance arm is in this latter position the plant is attached, and it is evident now that the tension on the thread would not be .04 gm., but .08 gm. It is desirable that the straw and pen should be exceedingly light, so as to interfere as little as possible with the sensitiveness of the balance.

Such an adaptation of the hand balance answers as a simple substitute for the more expensive multiplying appliances; moreover it possesses a greater degree of sensitiveness, although, as we have seen, the tension is not constant. For example, it may be .08 gm. in the beginning of the experiment, and only .04 gm. when the balance arm is in the horizontal position, but this variation we believe is practically unimportant with such small weights. The original apparatus of Sachs required a weight or tension of 20 gm.; that of Wiesner of 7 to 10 gm.; and the apparatus used by Pfeffer, even when compensated as fine as possible, must have a tension of 1.5 gm.; in general, however, this apparatus is used with a tension of 3 to 10 gm.

It is a well known fact that even a tension of a few grams affects the normal growth of a plant; notwithstanding this

fact, the relative growth curve produced by a large tension is correct, provided the first hourly registrations be neglected.

The registering apparatus consists of a cheap nickel clock costing seventy five cents. The minute hand is removed from its spindle and a piece of thin metal carrying the cylinder is put on instead; one end of this piece of metal is pointed and of sufficient length to answer as a substitute for the minute hand; the other end supports the cylinder and is bent outwardly, for the purpose of having the latter stand out some distance from the dial. At its point of attachment to the minute hand spindle it is considerably thickened, and the hole is made of sufficient size to allow the piece of metal to be driven on firmly. The cylinder consists of one turn of ordinary glazed paper, blackened on one side over a lamp, and having a length of about 36 cm. and a diameter of 2 cm.; it is fastened to the metal by means of soft wax. The cylinder makes a revolution once every hour, and by so doing the growth of the plant is registered by a series of parallel lines. For its successful revolution it is important that all the parts should be exceedingly light. The clock used by us was not in the least affected by the weight of the cylinder, and was capable of running 30 hours without re-winding. If, however, the cylinder is very large there is a possibility of the spindle slipping on its axis, which would prevent it from revolving. In case this should happen, or it should be desired to use even a larger cylinder, the difficulty is easily remedied by attaching a projecting rod supplied with an adjustable compensating weight to the other end of the piece of metal, so that its centre of gravity can be made to coincide with the axis of rotation; by careful compensation a weight of considerable size can be made to revolve successfully.

In a permanent apparatus a clamp provided with clips to fasten the cylinder and for the easy removing of the same from the spindle could be advantageously substituted for the piece of metal described above. If one wishes to obtain a continuous curve of growth the clock can be placed horizontally and a disk of metal be constructed so as to slip over the hour hand arbor. A cylinder of metal, wood, or even a glass-jar, covered with smoked glazed paper, or millimeter-ruled paper, can be placed upon the disk to record the growth. With millimeter-ruled paper it is necessary, of course, to substitute an ink pen for the metal one.

Suggestions on the classification of Metaphyta.

CONWAY MACMILLAN.

The sciences of botany and zoölogy are not yet sufficiently advanced, it may be, for the proposal of that system of classification which, at once comprehensive and natural, shall bind together all our ontogenetic and phylogenetic discoveries and generalizations into a harmonious and enduring structure. The season of patient toil in the acquisition of new facts in the departments of comparative morphology and embryology is not yet past; and to both the zoölogist and the botanist there is still a vast terra-incognita presenting its untried paths for the work of discovery and cartography. To indicate what seems to be a possibly fruitful line of investigation—or rather to suggest the continued investigation of an already indicated and partially explored region, from a somewhat different point of view than the ordinary one—is the object of this paper.

The bald statement that there exists a great group of living creatures with which students of biology have long been familiar, but of which there is as yet no classification, no Systema, no Tournefort or Linnaeus, and no compendium or monograph of any sort, borders closely on the sensational. From a certain point of view this is, however, a fair statement and one that can be defended. The groups to which reference is made have been studied since the time of Camerarius and properly understood since the days of Hofmeister. Their presence as organisms is nevertheless owing to the persistence of ancient habits of thought, largely overlooked by the students of to-day. The accepted classification of the plant kingdom into Protophyta and Metaphyta buries every vestige of the group, and it is only by modifying that classification that the lost tribes may be made to emerge from their obscurity. In the briefest manner let us examine the ascertained facts of progress which are considered of importance in determining the rank of successive series of plants and animals. First and lowest in the scale of differentiation are those organisms which can not be safely grouped either with the plants or with the animals. These are the Protista of Hæckel, the third kingdom. From them as a substratum the two phyla of plants and animals arise. In each branch of the primitive trunk the lower series of organisms are devoid of sex, purely vegetative even in their reproductive functions. These are

the Protophyta and the Protozoa, or if one should apply names to indicate the physiological character upon which the groups are founded, the Agamophyta or sexless plants, and the Agamozoa or sexless animals. With such transitional forms as Ulothrix and some of the ciliated Infusoria the two higher groups of organisms are introduced and we may distinguish the sexual plants, Gamophyta, from the sexual animals, Gamozoa. This latter branch is almost equivalent to the Metazoa, but the Gamophyta as here limited constitute but a small portion of the organisms which are included as Metaphyta. It is precisely here that the great hiatus between our classification of plants and animals is to be discerned. To appreciate properly the true condition of things is perhaps more easy if we divide the Metazoa and Metaphyta, respectively, into two co-ordinate groups. This is a division of organisms, not of species, and can be performed, I think, without violence to right thinking. There may be distinguished, then, in the plant phylum the Sporophyta and the Gamophyta, and in the animal phylum the Sporozoa and Gamozoa. A sporophytic or sporozoic organism might be defined briefly as one that develops primarily from a segmentation-cell (fertilized egg, parthenogetic egg or vegetatively apogamous cell) and normally forms in turn perfect reproductive cells or *spores*. In the plant phylum this group includes a most diverse and numerous series of organisms, from the four-zoospore-plant of Œdogonium to the moss-capsule, the ferns, club-mosses, pines, cycads, and all the herbs, shrubs and trees with which we are familiar. In the animal phylum, however, the Sporozoa would include only a very few and relatively insignificant organisms, chiefly among the Cœlenterata, and doubtfully extending among the Tunicata; that depending upon whether the views of Brooks or of his critics are to be accepted concerning the homologies of the salpa-chain.

With the division of the two branches, Metaphyta and Metazoa, it becomes apparent why the coördination of plants and animals under any of the systems is so unproductive of the most valuable systematic or philosophical results. We do not compare, habitually, the Sporophyta with the Sporozoa, but with the Gamozoa, thus missing the chance of determining the true parallelisms and homologies, if any exist. That sporophytic structures may not be compared (except physiologically) with gamophytic has already been shown by

Bower,[1] but it does not seem to be out of place to insist here that such structures and organisms are even less aptly compared with the Gamozoa.

It will be recognized as of high importance to discriminate in the two divergent phyla of plants and animals the truly double and parallel composition of each of the upper series. And, since the structural development in the two phyla varies reciprocally, it is not possible to compare them without clearly perceiving the double nature of each. For in the Metaphyta the sexual series has undergone progressive structural degeneration from the mosses to the highest of the Siphonogama, while in the Metazoa the sexual series manifests increasing complexity from the lowest Cœlenterata to the Primates. On the other hand, in the plant phylum, sporophytic organisms from the Œdogoniæ to the highest Metachlamydeæ show a constantly increasing structural differentiation; but in the animal phylum, sporozoan organisms are developed only low down in the scale and are discontinued long before the higher classes are reached. I have already indicated elsewhere what may be the reason for this remarkable difference between the two kingdoms[2], and it will suffice to suggest that the relatively great immobility of gamete-producing, that is sexual, plants is the primary cause of their defeat in the struggle for food, sunlight and organization with the more capable sporophytes. This supremacy of the sporophytes is so complete that all the higher gamophytic plants have been forced into a most abject condition of parasitism upon the sporophytic structures of their own species.

The great mass of the species grouped in the Metaphyta are, therefore, persistently and strongly dimorphic, and it is this dimorphism which distinguishes the plant from the animal phylum. The essential diagnostic character of the Metaphyta might be described, indeed, as sharply defined specific dimorphism. While the higher animals may, for each species, be separated into two groups of organisms differing only in sex, the higher plants may, for each species, be divided into perhaps four groups or organisms, viz., the pollen-bearing, the pistil-bearing, the male (pollen-tube) and the female (embryo-sac contents). This conception of the plant

---

[1] Bower: Antithetic and Homologous Alternation; Ann. of Bot. IV, 347–370, 1890.

[2] MacMillan: Amer. Nat. XXV, 22—25, 1891

species is of course rendered difficult by the as yet uneradicated error of considering pollen-tube and embryo-sac contents in the light of organs belonging to the sporophytic forms of the species. I have had occasion before, in these pages,[3] to call attention to the wellnigh hopeless confusion of botanical terminology in this region of the science. When Goebel speaks of the fertilized macrospore of Pilularia being attached to the ground by its prothallial rhizoids[4], or when Müller entitles a work "The Fertilization of Flowers," in which *fertilization* is not even mentioned, it serves to illustrate how deeply rooted is the fault of nomenclature which perpetuates the ancient errors of Camerarius, Linnæus, Sprengel and Erasmus Darwin.

It is clear that there must still be much study before botanists can hope to define their species correctly, to say nothing of grouping them in an enlightened manner. The emancipated zoölogists of the day are accustomed, with an air not unfamiliar, to deprecate the attention bestowed upon classification and systematic work by the botanists. They do not, perhaps, discern that in a way the problems of the botanist are two-fold as complex as their own, just as the organisms with which the botanist has to do are doubly complicated. Up to this time so little material has been examined that there are very few species of Gamophyta accurately described. It is inconceivable that there should not exist differences between the male plants of Salix and Populus, for example, in some way related to the differences between the sporophytes. What these differences are is a task for future investigation. It may be many years before the *Genera Plantarum* or the *Histoire des Plantes* of the higher Gamophyta is written; but such a work is imperative before it can be pretended that we are in a position to fitly describe or classify the plant phylum in a final manner.

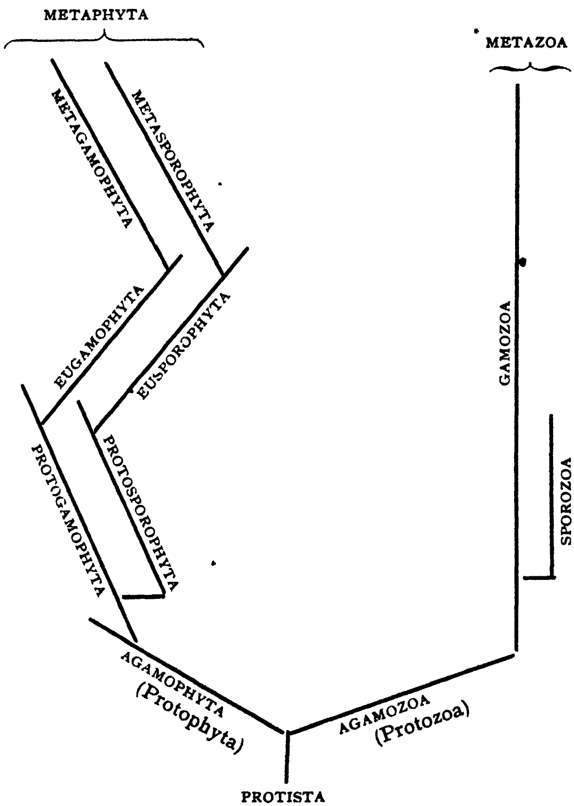
The evolution of sporophytic structures in the plant kingdom is so considerable that certain divisions should be noted in their development if they are to be set off against the far less important and less highly evolved group of the Sporozoa. Otherwise a wrong impression will be given in the comparison. With this in view it may be advisable to recognize in

---

[3]Bot. Gazette, XVI, 178, 1891.

[4]Goebel: Outlines of Classification and Special Morphology, Eng. tran., 243.

both the Sporophyta and the Gamophyta three fairly well-marked physiological divisions: first, the lowest Sporophyta are included in the gametophytic body and are therefore parasitic upon the sexual plant, e. g., Œdogonium, Chara, Riccia. Second, the higher forms are self-supporting and do not nurse the gametophytes, e. g., the higher mosses, the lower fernworts and club-mosses. Third, the highest forms act as host-plants for dependent, symbiotic gametophytes and



are so specialized, e. g., the seed-plants and the higher fernworts and club-mosses. These groups might be named respectively the Protosporophyta, Eusporophyta, and Metasporophyta, in order to facilitate reference without paraphrasing. Similarly, the lowest Gamophyta do not furnish nutriment for sporophytic structures of their own species, e. g., Ulo-

thrix, Fucus, Peronospora. The higher support dependent sporophytes, e. g., Œdogonium, Marchantia, Sphagnum. The highest are symbiotically parasitic upon sporophytic structures of their own species, e. g., the Isoetineæ, Selaginelleæ and Siphonogama. These might be named respectively the Protogamophyta, Eugamophyta, and Metagamophyta. It is this last division that constitutes the principal part of the unexplored region. The accompanying diagram indicates the grouping of living things here suggested.

University of Minnesota, Minneapolis.

Some fungi common to wild and cultivated plants.

BYRON D. HALSTED.

Reference is here made to the relation of the fungous parasites of wild plants, including weeds, to our crops whether of fruit, grains, or vegetables. This deleterious influence can best be brought out by taking up some of the worst fungous enemies to crops and showing the range of these parasites upon the surrounding wild plants.

Starting with the garden vegetables it is easy to find illustrations on every hand. Thus the lettuce mildew, *Bremia Lactucæ* Reg. is found up to date upon no less than forty-one species of plants belonging to the same family as lettuce and closely related to it. Many of these hosts for the mildew are common garden weeds and others inhabit the uncultivated ground.

The celery rust, *Cercospora Apii* Fr. now so destructive with truckers, is common to the carrot and parsnip also, and as the wild form of these abound without stint in many localities we need not wonder that the garden plants are partially destroyed by this pest.

There is a mildew of the spinach, *Peronospora effusa* Gr. that flourishes upon the pigweeds generally, there being no less than ten of these weeds that are thus infested and furnish a propagating place for the mildew of their patrician cousin grown on a salad plant.

The bean rust, *Uromyces appendiculatus* (P.) is one among a conspicuously destructive group of fungi that makes its home upon several species of wild beans.

But of wider range than any species yet mentioned is the mildew of the pea, *Erysiphe Martii* Lev. which renders it almost impossible to grow late peas. This fungus preys upon plants of at least six large and quite widely separated families and therefore in any neighborhood may have ample means at hand for keeping up its abundant stock of specimens.

The mildew of the cabbage and turnip, *Peronospora parasitica* (P.) is not an unmixed evil however, for because of its wide range it attacks the shepherd's purse, various mustards, and a number of other weeds. The hosts enumerated in a list recently consulted were thirty-five, and most of these are common plants in all parts of our country. Another fungous disease of the cabbageand turnip, namely, the club root, *Plasmodiophora Brassicæ* W. while as yet not recorded outside of these two hosts and the radish, very likely is at home with many of the other plants of the same order, but root diseases being out of sight are not easily found unless specially looked for.

Coming to the fruits and beginning with the lowest in stature, the cranberry, we see a fine instance of the question in hand in the gall fungus, *Synchytrium Vaccinii* Th. The following, mostly small shrubs growing along the shore or border of the bog, are afflicted with the same disease: azalea, sheep laurel, white alder, leather-leaf, huckleberry, and wintergreen. While these plants are members of the same family, they all differ considerably from each other and from the cranberry. It is evident that any remedy applied to be effective would need to include the infested shore shrubs.

The strawberry blight, *Sphærella Fragariæ* (Tul.) is met with upon wild vines of both our common species.

Sphærotheca Mors-Uvæ (Sch.) producing the gooseberry mildew and crippling an industry in this country, is found upon several species of our wild gooseberries. The writer recalls collecting fruit and young twigs entirely covered with the thick brown felt in the cañons of Colorado, where there were no cultivated bushes perhaps within five hundred miles. In like manner the anthracnose, *Glœosporium Ribis* (Lib.) that causes the premature dropping of foliage, is common to several species of currant.

The blackberry rust, *Cæoma nitens* (Sch.) is an especially important illustration of the relationship of wild plants to those close of kin that are cultivated in the garden. This conspicu-

ous rust grows upon the low blackberry, dwarf raspberry, thimbleberry, wild red raspberry, high blackberry, and sand blackberry. In a trip through the Carolinas in May last, this orange colored fungus was to be seen at nearly all times from the car window and one could but pity the cultivated species of Rubus, were there any grown in that afflicted region.

The diseases of the grape and in particular the mildew, *Plasmopara viticola* (B. & C.) are in general common to all wild species of the vine. The worst specimens I ever found were those of a wild plant in Iowa, many miles from any cultivated vines and the mildew was so bad upon the canes as to dwarf them to a few inches in length while they were covered from one end to the other with the white down of the fungus. Not only the *Vitis æstivalis*, *V. Labrusca*, *V. vinifera*, *V. riparia* and *V. Californica* are infested, but likewise the closely related Virginian creeper and more recently the Boston ivy are victims.

Among the plums and cherries we find four parasitic fungi to interest us in this connection, for they abundantly illustrate the fact of the close relationship of wild with our cultivated plants. First the plum pockets, *Exoascus Pruni* (Fcl.) are familiar to all as peculiar distortions of the fruit and stems of the cultivated plum, dwarf cherry, bird cherry, choke cherry, and some other species of the genus Prunus. The peach curl, *Exoascus deformans* (Berk.) also infests the dwarf almond, common garden plum, and three kinds of cherries, besides the peach. There is a rust, *Puccinia Pruni* Pers. which is very destructive in some parts of the country particularly to the peach and apricot in California. No less than ten species of the genus Prunus are subject to attacks from this enemy and the list includes the peach, apricot, plum and cherry, several of the last two being wild trees or shrubs.

Last but not least for the genus Prunus is the black knot, *Plowrightia morbosa* Sacc. As this enemy is of great magnitude it merits the naming here of the eight species that are subject to attack ; namely, the Chickasaw plum, *P. Chicasa* Michx.; the beach plum, *P. maritima* Wang., a thorny shrub on the sandy sea-shore; the wild yellow plum, *P. Americana* Marsh., a shrub or small tree along streams. Of the cherries, the choke cherry, *P. Virginiana* L., a small tree, is most frequently infested; but the wild black cherry, *P. serotina* Ehrh.,

a tree of the hedge rows, and the wild red cherry, *P. Pennsylvanica*, are also attacked.

It is evident from the illustrations that have been given of the diseases of the genus Prunus that there must be a close relation existing between the wild plants and those grown for fruit. What with the plum pockets, the curl, rust, and black-knot, it is evident that more attention needs to be paid to the wild hosts of fungi of cultivated plants before the latter can be free from their attacks of their present enemies.

There is a mildew, *Podosphæra tridactyla* (Wallr.) so wide-spread that it cannot be assigned to any one crop. Because very destructive upon the apple and particularly seedlings in the nursery it has been called the apple leaf mildew, but in some localities cherries, both old and young, suffer severely from it. It preys upon the quince, several species of the hawthorn, the June berry and various spireas. It seems to be a well established fact that plants that are closely related are quite apt to be subject to the same fungous enemies. But it does not follow that plants not near of kin will not have parasites in common. For example, within the past year it has been fully shown that bitter rot or ripe rot of the apple fruit is the same fungus that causes one of the dreaded decays of grapes. In like manner at the New Jersey experiment station it has been found that one of the worst enemies to the sweet potato is identical with a serious disease of egg plants. There seems little in common between the sweet potato and the egg plant and yet in the face of the fact of a common enemy it may suggest the importance of not following one crop by the other in those localities where they are both grown prominently and one or both are already more or less diseased.

In like manner it has been shown that a bacterial disease of the potato also affects the tomato and *vice versa*; and that was to be expected as both hosts are closely related; but that one disastrous form of melon blight is due to the same cause was unexpected because of the lack of kinship between melons and potatoes. The inference was that if melons were attacked cucumbers and squashes would also be. This was shown to be true and before the season was through it was found that much damage to the cucurbits generally was due to the bacterial disease.

Space forbids even the briefest mention of many other cases where plants wild affect the health of plants cultivated

by being the means of supply of fungus germs. One other instance that illustrates a phase of our subject not before touched upon may be given. The plant is a familiar one to many and painfully so to not a few. This is the apple rust (*Ræstelia*) that yellows the foliage of the orchard in July and shortens the crop at picking time. This fungus plays a double role and seems unable to get along with the apple tree alone. In a second and very different form, *Gymnosporangium*, it infests the cedar trees, there forming knots or galls that become conspicuous as gelatinous balls during the spring rains. These orange colored balls furnish the spores, which falling upon the foliage and fruit of the apple tree, produce the fatal rust. Later in the season the spores from the apple fungus go back, upon the wings of the wind, to the cedar and a new crop of galls is obtained for next spring's campaign against the orchard. In this case it is not wild apple trees or those of the same family that harbor the enemy, but a tree as widely separated botanically from the apple as is well possible. More than this, the fungus changes its form in passing from one to the other so that it was not until demonstrated by actual cultures that the relation, long suspected, could be fully believed. It is needless to say that the very evident method of procedure is to destroy cedar trees that are anywhere near the apple orchard. A single large gall-bearing cedar tree just outside the orchard fence may do more mischief than any enemy that is lurking within the enclosure.

It has been shown by means of a long series of examples that the evil influences of wild plants may act at long range. It is not necessary that their roots and those of the cultivated plants hould cross each other's paths in the soil or that their branches should interlock and overshadow one another in a deadly embrace. There is a more subtle bad influence than gross thieving or clutching by the throat. It is more in the nature of a poison that is sent out upon the air to be breathed in by the innocent wherever they may unwittingly meet the unseen but de idly germs.

Crowding of plants is bad, rank growth of weeds is worse, but the most fatal of all influences is that unseen group that steal away the health of the plants which lack nothing for room and enjoy high and thorough culture.

After all it is the host of enemies that swarm from the

plants outside the garden fence that try the patience of the husbandman. He has learned the methods of remedying the others, but the floating spores defy his keenest eyesight to discern and baffle his ingenuity to combat. The ways of the fungi are however being slowly and laboriously revealed by the microscope and conquered by the spraying pump. The former assists the latter, which as yet somewhat blindly fires effective "small shot" into the enemies ranks.

Proper seeding, fertilizing, and weeding will do much to assist, in warding off the deleterious influences of fungous enemies for healthy plants, while not proof against their attacks, are less liable to be overcome by them. Let therefore everything be done that is possible before the last resort comes and then the fungicide will have the greatest effect and yield the most returns. If so much of the smut, rust, mildew, mold, rot, and blight of our cultivated plants is propagated by the wild plants hard by, it may be wise for every crop grower to pay attention to what is thriving outside his garden wall. He cannot build it high enough to shut out the spores, but he can do much to diminish the number of these spores. Having done this, he can take up the spraying pump with a brighter hope of future success. There was a carcass, so to speak, in the pasture and he went out and buried it. Fungi are the basis of contagion and they infect at long range by means of their myriads of invisible spores. To learn of their ways and find better methods of resisting them make the burden of many a station botanist's labor today.

Rutgers College, New Brunswick, N.J.

Noteworthy anatomical and physiological researches.

The stem and leaf of the mosses.[1]

After alluding briefly to the principal works on the subject of his research, the author takes up the study of the anatomy of the aerial stem of mosses, distinguishing four types.

I. With uniform parenchyma containing chlorophyll bounded by: 1. A zone of aquatic cells; 1st type, Sphagnum. 2. An epidermal layer; 2d type, Thuidium.

[1] BASTIT, EUGENE: — Recherches anatomiques et physiologiques sur la tige et la feuille des mousses. Revue général de botanique. III (1891.). pp. 255, 306, 341, 373, 406, 462, 561.

II. With parenchyma differentiated into a central cylinder and parenchyma containing chlorophyll. 1. Central cylinder uniform; 3d type, Mnium. 2. Central cylinder differentiated into a medullary region and a surrounding pericyclic zone; 4th type, Polytrichum.

In using the term "pericyclic zone," the author remarks that "as to its development, it is not comparable to the pericycle of the phanerogams, and in general, a strict analogy cannot be established between the tissues of the stem of the mosses, a product of the asexual spore, and the stem of the higher plants, a product of the egg."

From this pericycle and central pith arise the leaf traces, which diverge from the center according to a law constant for each species. The trace reaches its maximum differentiation at the periphery of the stem as it passes into the leaf costa.

In mosses with a central cylinder, branch traces are found arising by differentiation of the medullary tissue and the pericyclic zone. Here, also, the traces follow a law of divergence constant for each species.

For his study of the leaf the author uses *Polytrichum juniperinum.* He regards the chlorophyllose lamellæ as an assimilative tissue and "from analogy, comparable to the palisade cells of phanerogams."

The subterranean stem of Polytrichum juniperinum is worked out with very interesting results. The outline in cross section is bluntly (tri)angular, and instead of the concentric arrangement seen in the aerial stem, the tissues are grouped radially into three sets of structures. In the apex of each angle, adjacent to the epidermis, is a hypoderm bundle, bounded on the inside by the hypoderm sector. This structure, being more extensive at the periphery than the bundle, is adjacent to the epidermis laterally for some distance, and narrows rapidly toward the center forming a rude Y which includes the hypoderm bundle between its forks. In contact with the inner end of the stem of this Y is the crescentic pericyclic sector, placed with its concavity outward and transverse to the stem of the Y. Bounding this sector, along its convex inner surface, is the central pith. Filling the spaces along the sides of the (tri)angular section are the three isolated cortical regions extending from the epidermis to the central pith.

In *Dawsonia superba*, a new Zealand relative of Polytrichum, instead of a single hypoderm bundle, there are generally three arranged radially, increasing in differentiation as they approach the exterior. The origin of the hypoderm bundles is thus plain. Their first elements arise by differentiation of cells of the pericyclic sector, *i. e.*, the bundles are of internal origin. The remaining elements are added from the hypoderm by the differentiation of its cells.

The relation of the peculiar triangular radial symmetry of the subterranean stem to the circular symmetry of the aerial stem is worked out and the transition described. The sectors and bundles of the angles extend laterally until adjacent ends meet and at the same time the radial extension diminishes, thus gradually bringing the radial arrangement into the concentric.

The more important physiological results are here summarized.

When an aerial moss (Polytrichum juniperinum was used) is subjected to an aquatic life, the epidermal layer of the stem and leaf is profoundly modified. The size of the cells is enlarged, the cuticle disappears and the slightly thickened walls retain a cellulose nature. The leaf loses its chlorophyllose lamellæ, the limb is reduced and the form slightly modified.

If the mosses are grown in air or in water, and the conditions of light and the orientation of the stem are varied, the stems are found to be very feebly negatively geotropic, and strongly positively heliotropic. Heliotropism is always predominant, and young shoots always grow toward the light whatever be their position.

Under the influence of humidity of the air, the leaves of certain mosses take two positions upon the stem: one corresponds to the hygrometric state approaching saturation, the position of expansion; the other, to a state approaching dryness, the closed position. In passing from the open to the closed position or *vice versa*, the leaf executes movements in both longitudinal and transverse directions. The movements begin in the leaves at the base of the stem, and extend gradually to those at the summit. The cause of the movements is found in the contraction aud the turgescence of the cellulose membranes of the leaf.

In both the open and the closed condition mosses respire in darkness, evolving CO_2 and absorbing O; the relation be-

tween their volumes remaining constant between 17° C. and 20° C. As regards the respiratory function, then, the mosses come into the general case of chlorophyll-containing plants. In the closed condition, the activity of the chlorophyll function (assimilation) diminishes nearly 50 per cent. The activity of both respiration and chlorophylline assimilation abates as the moss becomes dry. The inference may be made that these functions slacken during the summer with the mosses. It is in spring and autumn, when they are continually moist, that they elaborate nutritive materials most actively. This explains the appearance of the sporogonia during these seasons in so large a number of species.—RODNEY H. TRUE.

Anatomy of the stolons of Gramineæ.[1]

Although the function of the stolons in the Gramineæ is nearly the same, being at once reservoirs of nutritive matters and organs in the service of the vegetative propagation, the author has observed several differences in the interior structure. And he claims at the same time, that the two general types of stolons, which have been proposed by another author, Mr. Johanson,[2] are not sufficient, when the question is to characterize the structure of these organs in general. The two types mentioned by Mr. Johanson were distinguished by the different arrangement of the mechanical tissue, which is either central with a large cortex in contrast to a reduced pith, or nearly subepidermal with a large pith and a reduced cortex. But the author enumerates now several other anatomical features, observed in stolons of different genera, which occur under different conditions. He shows from the numerous intergradations between the stolons under-ground and the shoots above-ground, that the organization of the stolon depends upon a modification of the above-ground shoot. The structure of the shoot above-ground is well marked by the position of the mechanical tissue, which is either truly subepidermal or more or less distinctly subcortical, the bark being as a rule not very strongly developed. But there is a large series of modifications between this form and those derived from such shoots as show a tendency to replace stolons.

[1] P. HELLSTRŒM: Naagra iakttagelser angaaende anatomien hos græsens underjordiska utlöpare. Bihang Kgl. Sv. Vetensk Akad. Hdlgr vol. XVI, no. 3, Stockholm, 1891.

[2] Kgl. Sv. Vetensk. Akad. Hdlgr vol. XXIII, no. 2, p 30.

There is also given an account of the structure of the scale-like leaves, which cover the stems under-ground. These consist of a strongly mechanical tissue, which encloses the mestome-bundles, which here often contain a mere leptome. This, as it seems, peculiar fact is, however, easily explained, since the function of such leaves is not assimilatory; they do not need, therefore, the elements of the hadrome, but merely the leptome, for the supply of already prepared organic matters. The function of the strongly developed stereome in these leaves is not only to protect the leptome, but also to form a kind of support to the entire stolon.

As regards the endodermis, the author states several variations in the stolons, which he has examined, and which he refers to two groups: the so-called O-endodermis, the cells of which are thickened equally all around, while in the second one, the C-endodermis, it is merely the inner and the radial walls in which a thickening has taken place. A double endodermis was observed in some species of Triticum, Calamagrostis and others. (The writer takes here the opportunity to call attention to similar studies upon our native grasses, in which the vegetative propagation is so strongly predominant, and which might give still more extended illustration of the characters enumerated above.)—THEO. HOLM.

Studies upon germination.[1]

In a recent paper[1], Hildebrand describes the germinating plantlet of *Cecropia peltata* upon which he has observed a long series of different forms of leaves, from ovate to cordate, gradually succeeded by peltately three or five-lobed leaves until finally the typical form appears in the nine-lobed leaf. He shows also the gradual development of the "domatia" at the base of the petioles, in which the protecting ants take up their residence and feed upon a certain kind of exudation. These domatia are not present, however, at the very earliest stage of the plantlet, and the plant is therefore forced to provide another kind of protection against the climbing, leaf-eating ants. This is done by short branches developing from the lower leaves, having merely two sessile stipules, which are bent downwards and thereby prevent the animals from climbing the stem. It is only when about the twentieth leaf is de-

[1] Fr. Hildebrand: Einige Beobachtungen an Keimlingen und Stecklingen. Botan. Zeitung, 1892, Nos. 1, 2 and 3.

veloped that the stem has attained a sufficient thickness to give shelter to the protecting ants and to produce the exudation. The author has also observed a similar fact concerning the protection of ants in *Acacia cornigera.*

Another interesting fact, to which the author calls attention, is the difference in germination of closely related species. It is especially striking in the genus *Anemone*, and the more if we include the subgenera *Pulsatilla* and *Hepatica.* In *Anemone nemorosa*, for instance, the cotyledons are underground, and the first leaf is three-lobed; in *A. blanda* the petioles of the cotyledons are connate so as to form a long tube above ground, as also in *A. narcissiflora.* On the other hand the cotyledons of *A. fulgens* are above ground and normally with separated petioles, while some specimens differed by the partly, or in some cases even completely, connate petioles, as in *A. blanda.* In these species the plumule was kept under-ground, and it is now interesting to see, that in *Hepatica triloba* the plumule is above-ground, the cotyledons free, but here the first developed leaf is scale-like so as to protect the plumule in the first year. In some instances this scale-like leaf was replaced by a small three-lobed or reniform one. *Hepatica angulosa* germinates in the same manner as *Hepatica triloba*, while *Pulsatilla vulgaris* and *P. pratensis* differ from the other ones by having the plumule above ground with the first developed leaves of normal shape. The author describes also the germination of some species of *Dentaria*, which show similar differences.

That the shape of the leaves may depend on certain external causes is shown by *Oxalis rubella* and *Asarum.* In Oxalis the first leaf after the cotydedons is quinate, while the following is fleshy and scale-like; but when the first leaf is cut off the succeeding one attains its quinate shape instead of being scale-like. Asarum develops some scale-like leaves immediately after the cotyledons, and the author shows that by cutting off the blades of the cotyledons, some specimens of Asarum developed two small nearly normal leaves instead of the scale-like ones.—THEO. HOLM.

BRIEFER ARTICLES.

The identity of Asclepias stenophylla and Acerates auriculata.— The Synoptical Flora pertinently suggests the close relationship of these two supposed species. Under Acerates auriculata it is even stated that "unless the characters [i. e. of the two genera] are noted, it is very likely to be confounded with Asclepias stenophylla." Even so; for the two plants look to the naked eye exactly alike.

There was, in Mr. M. A. Carleton's collection of last season in Indian Territory, a plant, no. 248, which is a good Asclepias stenophylla, having all the characters of Dr. Gray's subgenus NOTHACERATES. The hoods, however, on comparison with those from herbarium specimens, were found to be longer, more compressed and more deeply notched on the back than usual, and the asclepiadaceous horn, reaching only a little above the sinus of the hood, was not at once found. This and the cautions in the Synoptical Flora led me to examine closely into the structure of anthers and hoods of all the specimens in the National Herbarium standing under the two above names, with the following result.

First, *Aclepias stenophylla* Gray is represented by three correctly named specimens in flower: one from Dorchester, Mo., collected by J. W. Blankinship; the second from Miami Co., Kansas, collected by Dr. J. H. Oyster; the third from Huachuca Mts., S. Arizona, collected by J. G. Lemmon. Mr. Carleton's no. 248 makes the fourth specimen. Nos. 1 and 2 agree with Carleton's plant in the compressed hoods and notched anther wings, but both have longer horns than the Indian Territory plant, while Lemmon's plant has both the notches in the anther wings and the sinus in the back of the hood very slight, and the horn shorter.

Second, *Acerates auriculata* Engelm. is represented by (1) an Arizona plant, Dr. Palmer's no. 604; (2) a plant collected on the Mexican Boundary Survey under Maj. Emory; (3) Wright's no. 552; (4) Wright's no. 1687. Of these, Palmer's plant has the anthers decidedly notched as in Asclepias stenophylla. The crest in the hood is present as in the first species, and reaches nearly to the sinus, but is not surmounted by any horn. In no. 2 there is still a trace of a notch in the anther wing. The crest in the hood is present, reaching over more than half its length. Nos. 3 and 4 have the crest likewise *present*, but the anther wings are merely rounded. They are however fully as wide near the base as near the top, if not wider.

From these observations, and especially when we take into consideration the long acknowledged fact that these two supposed species of

different genera are *exactly* alike in outward appearance, we cannot escape the conclusion that, in fact as in appearance, we have only *one* species. In every case of reputed Acerates auriculata crests have been found. The wings of the anthers too have been found to be, if not "decidedly auriculate," at least "dilated," certainly not "tapering at base." All of which characters bring these specimens under Asclepias, § NOTHACERATES, provided we allow the following modification of this subgenus.

§ 3. NOTHACERATES. *Anther wings more or less widening to the rounded base, which may or may not be notched or auricled; hood sessile, its apex emarginate or more deeply notched, with a narrow, wholly adnate, internal crest which may terminate above the middle of the hood without a horn, or may be more or less prolonged into a proper horn.*

The projection of this horn above the base of the hood-sinus gives the tridentate appearance mentioned in both the description of *Acerates angustifolia* Decaisne, and that of *A. auriculata* Engelm. I quote, the first from DC. Prodr. VIII, 522: "cucullis gynostegio sublongioribus, apice tridentatis"; the second from Bot. Mex. Bound. 160: "cucullis gynostegio globoso sessili brevioribus apice leviter tridentatis." And as for the stated discrepancy of relative length of anther-mass and hoods, and of the notch in the apex of the hoods, I have, in the material examined, observed all degrees of variation.

The different names of this species, with dates, are as follows:

Polyotus angustifolius Nutt., Trans. Am. Phil. Soc., Ser. 2, v. 201, (1837).

Acerates angustifolia Decaisne, DC. Prodr. VIII, 522, (1844).

Acerates auriculata Engelm. Bot. Mex. Bound. 160, (1859).

Asclepias stenophylla Gray, Proc. Am. Acad. XII, 72, (1876).

There is another species named *Asclepias angustifolia* Ell., Sk. 1, 325, (1821). So the specific name of Nuttall and Decaisne is not avail able. Engelmann's being the next oldest specific name, this species, it appears, should be named **Asclepias auriculata** (Engelm.).

Since writing the above note there has been found in a collection from Nebraska a plant that represents the Acerates side of this species, i. e., with the hoods destitute of horns, but the rudimentary crests present. This is an interesting find, as it makes the two forms practically co-extensive, at least in their northern range.—JOHN M. HOLZINGER, *Department of Agriculture, Washington, D. C.*

Bartram's Oak.—A long interval has elapsed since the Bartram oak was first made known and still its status has not been satisfactorily determined. Some contend that it is a hybrid. As the oak in question has been found at widely separated localities, although limited to a narrow

range extending from New York to North Carolina (and perhaps beyond this), one might suppose that this fact alone would be deemed sufficient to exclude the theory of hybridity in this case.

Within the last thirty years I have had the opportunity of observing it at different localities in Delaware and New Jersey and am now led to the conclusion that it is a variety of *Quercus imbricaria* Michx., of which we have here two forms, one with entire leaves. the other with lobed ones. On a single specimen, an oak growing in the Bartram Gardens on the banks of the Schuylkill at Philadelphia, Michaux founded his *Quercus heterophylla*. After describing it he remarks: "I was at first disposed to consider this tree as a variety of the laurel oak [meaning Quercus imbricaria] to which it bears the greatest affinity; but the leaves of that species are never indented, and not a stock of it exists within a hundred miles of Philadelphia." It is a tribute to the sagacity of this eminent botanist that, with only the lobe-leaved form before him, he had at that time so clearly discerned the affinity of this oak with Quercus imbricaria.

The evidence of this affinity may be seen when we compare (what is here taken to be) the entire-leaved form with the type and the lobe-leaved form of its variety. If further observation should confirm the conclusions here reached, and I believe that it will, it will then be proper to designate this oak by the name:

Quercus imbricaria Michx., var. *heterophylla* (Michx.).

a. ——— entire-leaved form.

b. ——— lobe-leaved form=Quercus heterophylla Michx.

In 1882 I found an oak in Salem Co., New Jersey, with entire leaves. Specimens from this tree were sent to Dr. Britton, who referred it to his *Quercus Rudkini* (Catalogue of New Jersey plants, p. 223). When first discovered I noticed some features characteristic of the Bartram oak to which I was inclined to refer it at the time. Later observations have now convinced me that it is the entire-leaved form of it mentioned above.

After some hesitation these views are presented in the belief that further investigation will confirm the conclusion here reached and decide a long pending question, the status of the Bartram oak.—A. Commons, *Wilmington, Del.*

The spines of Cenchrus tribuloides L.—It is a well known fact, at least to those who have carelessly handled the vile weed, that the wounds caused by the spines of the involucre of Cenchrus tribuloides are unusually painful and long continued. Personal experience in this regard led me to believe that there were some points about these spines that other spines did not possess and with a view to their

determination an investigation of their minute structure was undertaken. Under a low magnification a mature spine presents the appearance represented in fig. 1. Barbs of various sizes and, for the most part, uniform in shape are disposed irregularly over its surface, being more numerous and larger near the point, the tip of which is well supplied with them. The interior tissue of the spine (fig. 3) is made up wholly of very thick-walled cells, the thickening in many cases being of such an extent as to entirely obliterate the cavity. From the base to near the point of the spine throughout this tissue occur air cavities of different lengths but of nearly uniform width (fig. 1, *a*).

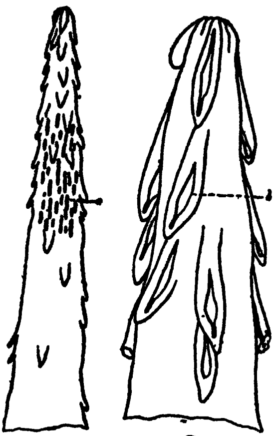


FIG. 1 and 2.—Spines of the fruit of *Cenchrus tribuloides:* 1, somewhat magnified; *a* cavities inside the spine; 2, end of the spine more magnified, *b* cavity of the barb

When examined under a higher magnification the true nature of the spine makes its appearance (fig. 2). Each barb is seen to have within it a cavity terminating, in the direction of the point, in a narrow tube and to be filled with a substance which in color is light purple. This, in all probability, is of a highly irritating nature and, it may be assumed, is the direct cause of the inflammation of the wound. The barb itself, or at least its point, is of very delicate texture, almost hyaline and is easily broken off; when this occurs the contents of the cavity are free to escape. The cavity seems to have no connection, in the mature barb, with the interior tissue. Neither does there appear to be any means by which the contents of the cavity may be ejected. Consequently they would escape slowly—ooze out—which would account for the prolonged irritation of the wound.—E.E. GAYLE, *Lieut. U.S. A.*

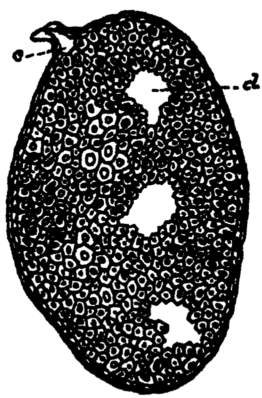


FIG. 3.—Cross section of spine: *c* section of a barb, *d* air cavity.

EDITORIAL.

BOTANISTS ARE a peaceable folk, so peaceable, we are almost inclined to add, as to be apathetic. They seem so averse to anything that has even the semblance of discussion that they will not even express an opinion lest it lead to controversy. If induction is worth anything we can substantiate this by adducing a host of facts on which it is based.

ONE HAS only to look back over the file of the GAZETTE to find that in the past five years there have been suggested numerous questions and movements, some of them of great interest to botanists. These the GAZETTE has presented, sometimes editorially, sometimes through its "Open Letters," and regarding some it has invited and even urged discussion for the guidance of those having the matters in charge. We cannot at this writing recall a single response to these invitations!

NEARLY TWO YEARS AGO the subject of a world's congress of botanists was broached in these pages and we endeavored to find out what our readers thought of the project, its desirability and its feasibility. Several other editorials have appealed for the same information but up to date not a line has come to us touching this matter. The world's congress auxiliary of the Columbian Exposition has now taken it up and proposes to have a botanical congress whether or no. The ideas of the management regarding this particular department are necessarily very general and crude, but it is still quite possible for botanists to direct efforts into proper channels. Will they take enough interest in it to do it? The committee having the preliminary work in charge will shortly issue an address containing a series of questions to which they desire categorical answers. If American botanists have not enough enthusiasm respecting an international congress to express their opinions when asked, we can hardly anticipate that they would have enthusiasm enough to come to such a congress or aid in the entertainment of their guests.

BUT BOTANISTS have a further duty. If they do not approve of the attempt and will not lend both encouragement and assistance, the committee ought to know it in time, so that the American botanists may not be committed to an invitation which they do not extend heartily. Already an announcement has been made by the auxiliary that such a congress is to be held. It remains for the botanists either to direct, it or to let it be known that this invitation if further extended does not come from them, and that it is only a part of the general commercial enterprise. The committee of botanists who have been asked to assist in the arrangements see very many difficulties to be removed before a personal and cordial invitation can be issued. If

proper backing can be secured, moral and financial, they think that a botanical congress can be made highly successful in all respects. The greatest difficulty which they have met so far has been —*your* indifference.

***

ANOTHER MATTER of great interest to botanical science is the proposed division of section F of the A. A. A. S. This proposal the GAZETTE opposed when it was made several years ago. We have seen reason to change our minds. Editorially and through the letter of Dr. Halsted, we have endeavored to find out how others regarded the proposition, but we have been unable to extract a single opinion, pro or con. So far as expression of their sentiments is concerned, the botanists might as well be dead!

CURRENT LITERATURE.

A manual of grasses.[1]

The study of the grasses of the United States has long been one of the special functions of the Botanical Division of the Department of Agriculture, and a vast amount of material has been accumulated in the National Herbarium. For many years Dr. George Vasey has been making this great collection of grasses his special care, and his various papers from time to time have testified to his critical study. It has been felt for a number of years that he should put the results of his labors in monograph form, so that botanists in general might share his wide knowledge. In answer to this demand, Volume III of "Contributions from the National Herbarium" opens with the first part of a "Monograph of the Grasses of the United States and British America." The second part, completing the monograph, is promised in a few months. The monograph is in regular manual style, with suitable keys, and a full index which includes synonymy. The author has done a good service to American botany in bringing together our scattered accounts of North American grasses, and the monograph will undoubtedly stimulate the wider study of this very important and very critical group. The Department, as well as the Botanist, is to be congratulated upon the evident desire to cultivate botany for its own sake, and to use some of its money and material in rendering service to the botanical world, as well as to purely agricultural interests.

[1] VASEY, DR. GEO.—Monograph of the Grasses of the United States and British America. Contributions from the U. S. National Herbarium, Vol III, No. 1, pp. xiv, 89. Issued, Feb. 25, 1892. Government Printing Office, Washington.

Thin wood sections.

The usefulness of well prepared transparent sections of various kinds of woods for numerous instructive and illustrative purposes, is conceded by every one, and by no one more than by the person who has had the privilege of using them. About ten years ago Mr. Henry Brooks, of Boston issued a set of seventeen species of woods, each species represented by three sections, a radial, a tangential and a transverse one, neatly mounted upon cards behind mica slips. Somewhat later a larger set, representing about 200 species of woods, mounted much in the same manner, was prepared by Charles W. Spurr, of Boston, under the direction of Dr. C. S. Sargent, using material from the "Jesup collection" of the Central Park museum, New York. Only a limited number of this set was issued.

There is now in course of publication a third set of wood sections.[1] These are prepared and mounted in a similar manner to those of the preceding sets, except that mica facing is not used, and that a number of minor details are added to increase their usefulness. A new feature of much importance is a well arranged accompanying text.

The author is Mr. Romeyn B. Hough, son of the late Franklin B. Hough, who was for some time U. S. Commissioner of Forestry, and throughout a long life was a student of our native ligneous flora, being the author of a treatise on the "Elements of Forestry," and of numerous other works of a kindred nature. The son has inherited his father's love of the forests, and he has entered into the preparation of the present work with the rich accumulations of information at hand brought together by his father, and with a strong personal enthusiasm.

The work is to be issued in parts of twenty-five species each, each part with a suitable text. The parts will appear as rapidly as they can be prepared, and the whole work is expected to eventually embrace all the most important woods of the United States. Two parts are already issued. The price is five to ten dollars per part according to the style of binding.

The work has a scientific and economic interest, both of which features are admirably met by the accurate naming and preparation of the material and by the extended and important information given in the text. The form in which the work is put up is very ingenious and handy, each part making a volume resembling an ordinary book, although the sections are upon free cards.

---

[1] HOUGH, ROMEYN B.—The American woods, exhibited by actual specimens and with copious explanatory text. Lowville, N. Y., pub. by the author. 8vo. Pt. I, 1888. pp. vii+79. figs. 42. 27 cards bearing three wood sections each. Pt. II, 1891.

A large series of lantern slides of wood sections is also prepared by the author, and sold separately. They make particularly beautiful and instructive objects for class use. Untreated wood-section cards of all sizes up to 4½ by 6 inches are also made. They have a fine ivory-like appearance, and may be used for a great variety of useful and decorative purposes.

The Oak.[1]

Looked at as an independent treatise, we have in this book a succinct account of the development, anatomy and economic relations of the English oak, forming a compact little volume that will be useful to every student of forest biology. Space limitations have sometimes necessitated a lack of fulness in statement that tends to obscurity, but in the main the work is good, clearly put, and accurate.

The Modern Science Series, of which this is the third volume, aims, so its editor, Sir John Lubbock, says, "to give on each subject the information which an intelligent layman might wish to possess." We can hardly imagine, however, that any layman, even an intelligent one, would be able to read this book understandingly unless he had had thorough instruction in vegetable anatomy. For example: the account of the course of the fibro-vascular bundles of the stem and their relation to the leaf traces (pp. 43–51) is hard reading even for one who has considerable previous knowledge of this subject both by reading and dissection. This fault, which can be considered a fault only in the light of the editor's preface, runs all through the book.

In these days when University Extension is coming to be such a popular thing we can foresee for this book a useful service. A course of lectures on the life history of plants could be built around it, and the book then be recommended for the supplementary reading which most of such courses require. The simplification and expansion by the lecturer would counterbalance the technicality and conciseness of Mr. Ward, qualities which under such circumstances become desirable. The number of books which can be used in this way is yet very limited and we are glad to recommend this one for this purpose to any who are wondering what they can find for such use.

The illustrations are in the main very good. Some are spoiled by too much reduction (e. g. those on pp. 57, 58, 59, and 111) and some are rather to large for the page, especially those in the chapter on the cultivation of the oak. The make up of the book is very attractive.

---

[1] Ward, H. Marshall:—The Oak, a popular introduction to forest-botany. Modern Science Series (edited by Sir John Lubbock) vol. III. 12mo. pp. vii+175. New York: D. Appleton & Co. 1892. $1.00.

Minor Notices.

MR. H. J. WEBBER has published an Appendix to the Catalogue of the Flora of Nebraska. The flora of this very interesting state is being vigorously investigated, and as the somewhat arbitrary line between the eastern and western manuals runs through it, such a list as this appendix contains unusually affects their contents. The appendix adds 432 species to the original catalogue, and the recorded Nebraska flora now contains 48 protophytes, 115 zygophytes, 27 oöphytes, 808 carpophytes, 60 bryophytes, 19 pteridophytes, and 1245 phanerogams; in all 2322 species.

THE 23d Contribution from the Herbarium of Columbia College is entitled "The American Species of the Genus Anemone and the Genera which have been referred to it," by N. L. Britton. In this paper Dr. Britton reviews the various notions as to generic limitations, and casts in the weight of his authority against consolidation, regarding Anemone and Pulsatilla as worthy of being considered distinct genera. Hepatica and Anemonella are also kept distinct, the latter bearing the older generic name *Syndesmon* Hoffmg. In addition to these genera which are represented from North America, the other American genera, Capethia and Barneoudia, are considered. Pulsatilla, thus revivified, contains two species, the old Anemone patens, var. Nuttalliana, appearing as P. hirsutissima (Pursh). Anemone, thus delimited, is credited with 28 species, 9 of which are confined to South America. Two new species of the United States are *A. Tetonensis* Porter, of Idaho, and *A. Lyallii* Britton, of the northwestern Pacific region.

NOTES AND NEWS.

A PRELIMINARY LIST of the mosses of Lancaster County, Penn., has been published by John K. Small of Lancaster, and enumerates 150 species.

MR. F. W. DEWART has been appointed general assistant in botany at the Missouri Botanical Garden *vice* Mr. Hitchcock, who has gone to Manhattan, Kans. His duties began March 1.

THE FEBRUARY NUMBER OF AGRICULTURAL SCIENCE contains two botanical articles: "Notes on the flora of Thunderhead Mountain, Tennessee," by T. H. Kearney, Jr., and "Some recent contributions to mycology," by F. L. Scribner.

PRESIDENT JOHN M. COULTER is lecturing to large University Extension classes in Evansville and New Albany, Indiana, and Louisville, Ky. Each course includes twelve lectures upon the general morphology and physiology of plants.

IN ADDITION to continuations of articles already noted, the March number of the *Forstlich-naturwissenschaftliche Zeitschrift* contains the beginning of a paper on the "Influence of living and dead soil covering on the temperature of the soil," by Professor Dr. Ebermayer of Munich.

IT IS ALWAYS interesting to follow the track of rare plants, and some articles concerning the proper home of Calypso, were lately published in the GAZETTE. It seems, however, that it is also quite at home in Europe, as Mr. H. Samzelius happened to find not less than 400 flowering specimens in a birch-forest near Tornio river in the Tornio-Lapmark last June.[1]—T. H.

A COMMITTEE of prominent botanists has undertaken to remove Stephan Endlicher's body from its unmarked grave in the Matzleinsdorfer Cemetery near Vienna, to the new Central Cemetery, and to provide a suitable monument to the memory of this distinguished botanist and philologist. Contributions may be sent to the k. k. zoologisch-botanische Gesellschaft, Wien 1, Herrengasse 13.

MR. F. W. ANDERSON'S valuable mycological collections have been donated to Columbia College, New York. He was associated at his death with Dr. and Mrs. N. L. Britton, and his collection being in their care was donated to that institution. His large herbarium of phanerogams is now in the possession of Rev. F. D. Kelsey undergoing revision, and when this is finished it is donated by Rev. Joseph Anderson to Deer Lodge College, Montana, as a memorial of his son.

ALIDA OLBERS has investigated the structure of the pericarp of the Labiatae.[2] The investigation shows that the structure of the pericarp in the Labiatæ is very uniform, although the author has succeeded in finding several differences. These structural differences do not correspond, however, to the systematic position of the genera in which they have been observed; the same group may show different types, while the same type may occur in several and mutually different groups.—T. H.

DR. M. C. COOKE, the editor of *Grevillea*, announces that with the issue of the next number (June) the twentieth volume and the series will come to an end. His fickle health and increasing years render necessary his withdrawal from the editorship. Whether the journal will be continued in other hands or whether it will come to an end remains an open question. We hope that if it is continued it will cease to be a "species mill" and become an English journal with somewhat the scope and standing of Hedwigia and other cryptogamic periodicals.

THE SOUTHERN TOMATO BLIGHT is treated by Dr. Byron D. Halsted in bulletin No. 19 of the Mississippi Agric. Exper. Station. This is the first time the disease has been critically studied, although it appears to have been known for some time, and to be of considerable commercial importance. Prof. Halsted decides that it is of bacterial

---

[1] Botaniska Notiser, 1891, p. 174.

[2] Bihang till Kgl. Sv. Vetensk. Akad. Hdlgr., Vol. XVI, part III, Stockholm, 1891, 20 pp., 2 plates.

nature, and identical with a blight of potatoes. He also inclines to think that it is caused by the same microbe that produces the disease in melons, an account of which was given in the preceding volume of this journal, p. 303.

CROSSING VARIETIES OF CORN has been conducted at the experiment station of Kansas since 1888. The results obtained in 1891 are given in bulletin No. 27, by Prof. W. A. Kellerman. The general conclusions which Prof. Kellerman draws from the whole series of experiments are "that the characters of so-called distinct varieties of corn can, by means of cross-fertilization, be made to blend more or less completely," and that the "blended form, or 'cross,' so far as our experiments indicate, does not generally (if kept free from contamination by foreign pollen), revert perceptibly to the parental types."

MACARONI AS A SOLID MEDIUM upon which to cultivate bacteria is advocated by Prof. G. de Lagerheim, (Centr. f. Bak. u. Par., XI, 147). The sticks are cut into pieces about 4½ cm. long, placed in test tubes, enough water added to cover them, and then boiled about fifteen minutes, or until well swollen and white. The water is now poured off, the tubes closed with cotton plugs, and steam-sterilized in the usual way, when they are ready to use. It is intended to take the place of potato in a measure, as more convenient and satisfactory, and also to add another culture medium for diagnostic purposes, as some bacteria have already been found that will grow upon potato but not upon macaroni.

AT THE REQUEST of Baron Ferd. von Mueller in Melbourne, Baron Otto Nordstedt has undertaken the work of writing a monograph of the Australasian Characeæ, the first part of which has lately been issued by R. Friedländer & Sohn, of Berlin. References are given to preceding papers, which deal with the same subject. Allen's "Characeæ of America" is especially commended for the study of the anatomy and morphology of these plants. Of the ten species, described in the first part, following are new: *Nitella partita*, *N. tumida* and *Chara Leptopitys* A. Br. subsp., *subebracteata*. The paper is accompanied by ten plates illustrating the plants in natural size, accompanied by numerous enlarged details.—T. H.

THE PRESENT SYSTEMATIC arrangement of the phæosporic algæ is not satisfactory. A valuable contribution in regard to the correct understanding of several species heretofore referred to *Adenocystis* has been given by Prof. Kjellmann.[1] He revises the following species: *A.* (*Lessoni* var.?) *Californica* Rupr., *A. Lessoni* Harv., *A. Durvillaei*? Herb. Holm. in sched. and *A. Durvillaei* (Bory) et auct. The result of his examination is that these really represent four different genera, belonging to four families namely: *Adenocystis* Hook. fil. et Harv. of the family LAMINARIACEÆ; *Coilodesme* Strömf., by Strömfelt referred to CHORDARIACEÆ; *Corycus* n. gen. of PUNCTARIACEÆ; and finally a yet undescribed genus of the family SCYTOSIPHONACEÆ.—T. H.

[1] KJELLMANN, F. R.: Undersökning af naagra till slægtet Adenocystis Hook. fil. et Harv. hænförda alger. (A study of some Algæ, which have been referred to Adenocystis by Hooker fil. and Harvey.) Bihang till Kgl. Sv. Vetensk. Akad. Hdlgr., vol. XV, Part III, Stockholm, 1890.

TWO NEW SPECIES of red mycoderma are described and figured by A. Lasché in *Der Braumeister* for March (v. 278). These belong to the class of plants usually called yeasts, but in reviewing the literature he points out that no true colored yeasts, i. e. spore-producing Saccharomyces, have yet been described. The more interesting of the new species is *Mycoderma Humuli*, found upon the leaves of the hop, Humulus Lupulus. It has the marked characteristic of producing new cells by first forming a promycelium, instead of budding directly. The other species was found by accident in making plate cultures, and so came from the air. It is named *M. rubrum*, and shows some tendency toward the occasional formation of promycelium.

AT THE LAST MEETING of the Chamisso Botanical Club, of Berkeley, Cal., one of the members enumerated ninety-eight species of phanerogamic plants in flower in January. The number, though considered quite large, was not the result of systematic investigation but only those casually noticed in flower about Berkeley and on two excursions to the opposite side of the bay. The limits of the list are within ten miles of San Francisco. It is noteworthy that a large proportion are introduced plants which here find congenial conditions, or species of extensive or nearly world-wide range. Professor Greene called attention to the manner of leaf propagation discovered in *Cardamine Californica*, a method known only in two other Californian plants and in few others elsewhere. Other members read papers of local botanical interest.—W. L. JEPSON.

UNTIL QUITE recently it has been assumed that the growth of the mistletoe was necessarily prejudicial to the tree upon which it grows. With the discovery of "symbiosis," or that arrangement whereby two plants live in intimate association one with the other without injury to either, but perhaps with reciprocal advantage, a different view has been taken, and an apple tree is supposed to be advantageous to the mistletoe growing on it in summer, while in winter the evergreen Viscum supplies the deficiency which the apple experiences by the loss of its leaves. M. Gaston Bonnier has been putting the matter to the proof by estimating comparatively the changes which occur in the composition of the two plants and of the atmosphere during growth. For half the year it is found that the mistletoe assimilates food by its green leaves for the denuded apple tree. We cannot give the details of M. Bonnier's experiments, but it is sufficient to say that they completely bear out the idea of perfect "symbiosis," or mutual adaptation, and that save by mechanical obstruction, the mistletoe does no harm to the tree on which it is growing.— *Gard. Chron.* Jan. 23. How is this conclusion borne out by our common American mistletoe?

PROFESSOR G. DE LAGERHEIM, director of the botanical garden at Quito (Ecuador), announces the discovery of European Uredineæ near Quito.[1] He has observed *Puccinia coronata* upon plants of an Avena, the seeds of which had been introduced from Europe; which is the more interesting since none of the species of Rhamnus, upon which the corresponding æcidium lives, have been found yet in Ecuador.

[1]Botaniska Notiser, Lund 1891, p. 63.

The only explanation of this peculiar fact seems to be that the germinating oats were infected with teleutospores of P. coronata, and that both the æcidium and the uredo-generation were passed. According to Plowright,[2] who succeeded in infecting young plants of wheat with sporidia of *Puccinia graminis*, the æcidium generation may be passed, and Prof. Lagerheim supposes the same to be the fact with P. coronata in Quito. He has also found P. graminis near Quito, where it occurred on some varieties of Avena, although none of the species of Berberis, nor even Mahonia Aquifolium, which usually are bearers of its æcidium generation, exist in Ecuador. He is therefore inclined to explain the occurrence of Puccinia graminis in the same way as that of P. coronata.—T. H.

MM. Dewevre and Bordage propose in the February number of the *Revue général de Botanique* a method of analyzing and recording the movements of plants photographically. Instead of the interrupted observations as in the method used by Darwin and later investigators, they succeed in getting a continuous record. The difference is the difference between the occasional observations with an auxanometer and the record obtained by the registering instruments. The plants to be observed are placed in a dark box whose sides are pierced by apertures for the fronts of two cameras, one vertical and the other horizontal. To the tip of the organ to be studied is affixed a spherule of wax which furnishes the bright point whose movement makes the tracing on the sensitive plates. In case it is desired to avoid the alterations produced by darkness the plant and cameras are similarly arranged, uncovered. The dark background for the bright point is secured by placing opposite the cameras long tubes of proper diameter whose inner surfaces are blackened. In both cases the pot needs to be supported so that it can be lowered as growth occurs. The method is certainly a very ingenious one, and capable of valuable service. For the details and necessary cautions we must refer to the paper itself.

In order that the exhibition of weeds at the World's Columbian Exposition may be large, and representative of all sections of the country, Dr. Byron D. Halsted, of the N. J. Experiment Station, New Brunswick, N. J., (having this feature in charge) asks for specimens of the worst weeds from all states and territories. It is suggested that each botanist or local collector, who may be pleased to assist in the work, secure at least three specimens each of the worst weeds in his state or section. In making the specimens it is important that collectors obtain seeds, seedlings in various stages of development, the root system, the flower and flower cluster, and the seed vessels. It may be necessary, therefore, to secure these various essentials at different times during the coming season. If the weed is a large one stress is laid upon the procuring of specimens while they are small enough so that the whole plant, roots and all, can be mounted, without bending, upon a herbarium sheet of ordinary size, that is, not over a foot in length. Persons who will aid Dr. Halsted should signify their intention, and allotments will then be made according to the locality. It is hoped that each state in the Union may be represented by specimens in this national exhibit of our worst weeds. The collecting must all be done during the present season, and the specimens sent in for mounting, labeling, etc., by December 1st.

[2]The connection of wheat mildew with the barbe…

Yrs. very truly
Sereno Watson

INTERIOR of GRAY HERBARIUM

BOTANICAL GAZETTE

MAY, 1892.

Sereno Watson.

JOHN M. COULTER.

(WITH PLATES VI AND VII [1])

Sereno Watson was born December 1, 1826, at East Windsor Hill, Connecticut. He graduated from Yale College in 1847; taught school for several years in different states; studied medicine at the University of New York; was a practicing physician for two years at Quincy, Illinois; was secretary of the Planters' Insurance Company of Greensboro, Alabama, from 1856 to 1861; became a professional botanist in 1868; was botanist of Clarence King's U. S. Geological Survey during the seasons of 1868 and 1869; became Professor Gray's assistant at Cambridge in 1871; and was made Curator of the Gray Herbarium and Library in 1888, a position which he held at the time of his death, March 9, 1892.[2]

Such are the prominent dates and positions connected with the life of one who, at his death, was the most distinguished American student of systematic botany. His work will speak for itself, but the real flavor of his quiet life is known only to those of us who were fortunate enough to be intimately associated with him. To the chance visitor or casual acquaintance he seemed painfully reticent and unresponsive, but he hesitated at no trouble in serving those who sought his help; and many American botanists will always cherish the memory of his kindly, unrequited assistance. The priceless herbarium, under his care, still had the atmosphere of helpfulness so characteristic of its great founder. To turn from the memories of the friend to the cold recital of the work of the botanist is a necessary but uncongenial task.

[1] The portrait (plate VI) is from a photograph by Pach, taken in January, 1887. It is selected by a friend as the best likeness of Dr Watson. The herbarium interior (plate VII) is from a photograph taken about 1880

[2] I am indebted to "Garden and Forest" (March 16) for the facts with reference to Dr. Watson's earlier life.

Sereno Watson appeared suddenly in the botanical world. So far as we know, he had no puerile work to lament, the common experience of most botanists, but when known as a botanist at all he was in the foremost rank. This stepping at once, full-equipped, among the leaders, without any preliminary service, is one of the distinguishing marks of his botanical career.

His apparently accidental connection as botanist with the U. S. Geological Survey under Clarence King was the occasion of his sudden celebrity as a botanist. Botanical collectors had visited the great west before and have multiplied since, but Watson brought back from the Great Basin region not only a magnificent collection of plants, but also such an ability to study it, that his report, technically known as the "Botany of the 40th parallel" (vol. V of the Clarence King's Reports), has become one of the classics of American botany. The appearance of this work in 1871 was the first announcement that America had another great botanist.

From that time he was the constant associate of Dr. Gray, devoting himself entirely to the study of the North American flora.

In 1876 there appeared the first volume of the Botany of California, a most elaborate presentation of the unique flora of the Pacific coast region. This volume was the joint work of Dr. Watson, Professor Brewer, and Dr. Gray; the first two elaborating the Polypetalae, the Gamopetalae falling to Dr. Gray. The second volume, appearing in 1880, was the sole work of Dr. Watson; and it was in this volume that his presentation of the mosses, although not a professed bryologist, showed the remarkable taxonomic power he possessed. This contact with the mosses led to his being asked, upon the death of Mr. Thomas P. James in 1882, to take editorial charge of Lesquereux and James' "Mosses of North America," then in press. This involved a vast amount of critical and editorial labor, and must have seemed a sad waste of time to a man overwhelmingly busy in other directions.

In 1878 there appeared the first part of his "Bibliographical Index", including the Polypetalae of North America. It is a great loss to American botany that Dr. Watson was not able to prepare the remaining parts, especially those including the Apetalae and Monocotyls. The only part that appeared, however, has been an immensely useful book; and

it must always stand as a monument to the patient, systematic, drudgery-enduring nature of the man. It is far more than a careful collaboration of references and synonymy; for it necessitated the revision of many groups and contains views unrepresented elsewhere. I imagine that no book has been more consulted by students of the North American flora than this one; in fact, in lack of a volume of the Synoptical Flora covering the same ground, this volume of the Bibliographical Index was all that made the study of North American Polypetalae possible in many herbaria. The number who have leaned upon Dr. Watson for synonymy and dates is far greater than their acknowledgement of such laborious but thankless service.

At the death of Dr. Gray, the writer had in hand a revision of Gray's Manual upon entirely new lines. The chief purpose was to enlarge its range and revise its nomenclature, but Dr. Gray had also planned a different style of presentation, and had furnished complete manuscripts of two or three small families as patterns. This work was brought to a sudden close by the death of Dr. Gray and the transfer of his copyrights to Harvard University. As is well known, however, the manual was revised, the work being assigned to Dr. Watson and the writer. It was really an imposition upon the former, for he could not take such responsibility lightly and did far more time-consuming work of revision than the necessities of the case demanded. The result was a manual more closely following the old lines than Dr. Gray had intended, but still fully as useful to the vast majority who use it.

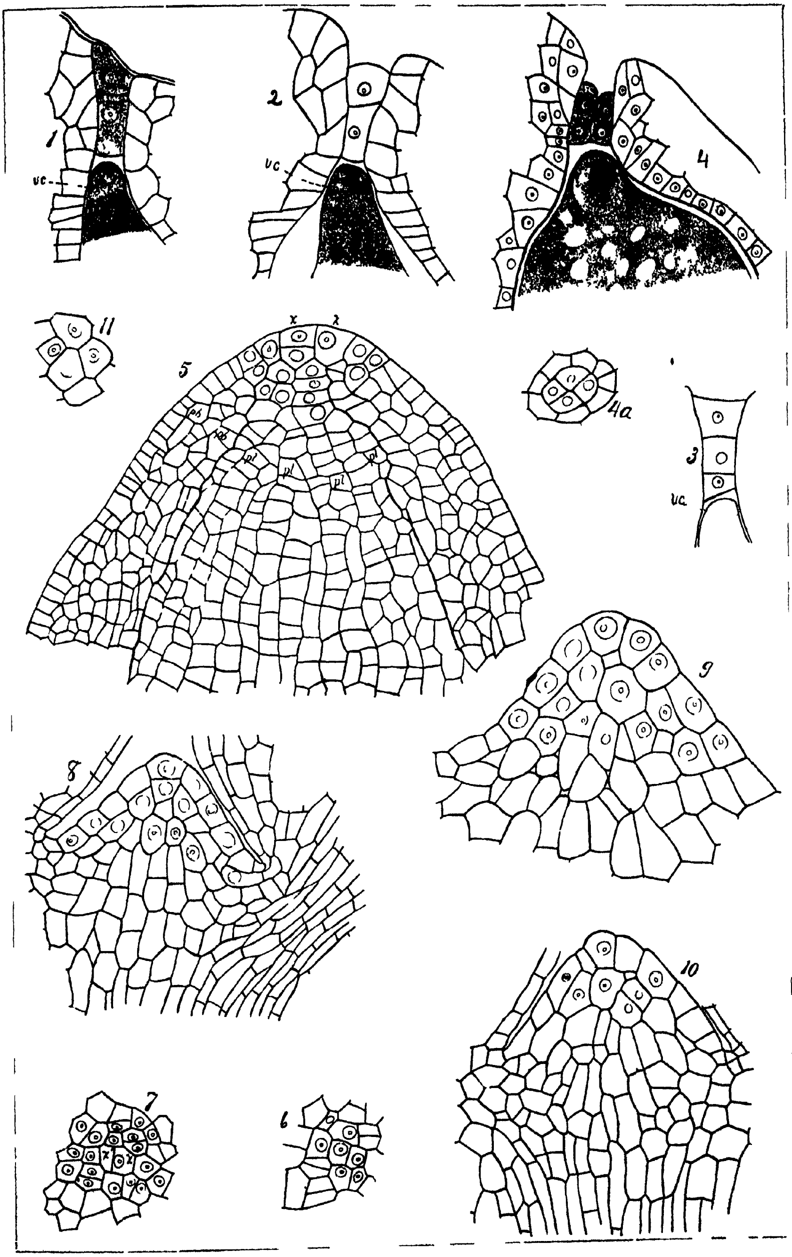
The series of "Contributions to American Botany" which bears Dr. Watson's name represents some of our most important systematic literature. The series reached 18 in number, and extended from May 1873 to July 1891, chiefly in the Proceedings of the American Academy. In this series, his name is associated with the revision of the following orders: Chenopodiaceae and Liliaceae; and with the following genera: Lupinus, Potentilla, Œnothera, Ceanothus, Trifolium, Lathyrus, Megarhiza, Peucedanum, Lychnis, Eriogonum, Chorizanthe, and Rosa

A large amount of his time was occupied in elaborating the rich Mexican collections of Pringle, and scores of new Mexican genera and species will always speak of his connection with that flora.

After Dr. Gray's death it was a fitting thing to so arrange Dr. Watson's time that he could have abundant opportunity to continue the "Synoptical Flora," and botanists were satisfied that this work would be continued more nearly in the spirit of its great author than in the hands of any other botanist. But now not a published page has been added, and our greatest botanical work bids fair to remain even more incomplete than its forerunner, the Flora of North America. However, much work had been done among the polypetalous orders, and it is to be hoped that that part at least can appear with something like completeness.

As a botanist, Dr. Watson was thorough and painstaking, the charge of hasty conclusions never having been laid at his door. His whole training and disposition compelled him to occupy a conservative position in the midst of the perturbations of sequence and nomenclature. He had to be very sure that right conclusions had been reached before his consent could be given; but his conservative views were never offensive and never appeared in public discussion. His disposition was simply to wait until things became more settled, and in the mean time to work quietly along in his own way. It has always seemed to the writer that Dr. Watson was remarkably gifted for doing safe systematic work. Lacking the grasp, the originality, the inspiration of our greatest botanist, he yet had that clear analytic vision and unflinching patience that lead to the best results. As I have heard him say: "I never can remember anything, but I can work it out"; and this seems to express his peculiar quality. It must be said in justice, however, that Dr. Watson's position in matters of ordinal arrangement was not so conservative as his writings would seem to indicate. His views on this point were clear and original. Recognizing the temporary nature of our present fabric of classification, he has frequently discussed with the writer the changes which were imminent, and only withheld a concrete public expression of his views because he did not deem his knowledge or any one's knowledge of affinities sufficient.

Systematic botany has lost another one of its great exponents, another one of that generation which is fast passing away. What the new generation is to do for the science is hard to predict, but it is evident that as the old leaders disappear we are to become more of a democracy. Sereno Watson's



MOTTIER on TSJCA and PINUS

place in the study of botany of this country can not be filled, for the conditions which made him have disappeared; but to many of us this loss will appear secondary, because we especially cherish the memory of the kind and helpful friend.

Indiana University, Bloomington.

On the archegonium and apical growth of the stem in Tsuga Canadensis and Pinus sylvestris.

D. M. MOTTIER.

(WITH PLATE VIII)

To determine the true relationship existing between the different groups of the plant kingdom is yet a problem of great interest to botanists. The genealogical tree is still largely hypothetical and must necessarily remain so for some time to come. Now and then modern research fills up a gap or throws some light on the true line of development.

The gymnosperms, holding as they do a position between the pteridophytes and angiosperms, are perhaps as interesting as perplexing. It is, however, chiefly in the study of the reproduction, the development of the embryo and the meristems of stem and root that we are to look for the true affinities of the neighboring groups.

Several representative types of the gymnosperms have been carefully studied by Hofmeister and, later, by Strasburger and others. Since more accurate methods have come into use some of the work done by these botanists has been repeated, especially in cases concerning which there was doubt or difference of opinion.

Having had material in abundance, I recently made a careful study of the development of the archegonium in Tsuga Canadensis and Pinus sylvestris and found that in a few details my results do not quite agree with the account of Strasburger.[1] This investigator states that he can not affirm Hofmeister's statement that the neck of the archegonium of Tsuga Canadensis consists of two cells, one lying above the other, but that it remains one-celled, and only in rare cases did he find two. In a large number of specimens examined I found

[1]Die Befruchtung bei den Coniferen, p 6. Jena, 1869

the neck to be frequently of two cells (figs. 1 and 2). In one instance I found the lower cell divided by a cross wall, thus making three cells in all (fig. 3). This, however, is exceedingly rare for it was the only case observed out of the large number of ovules sectioned. In Pinus sylvestris the cells of the neck formed two layers instead of one (fig. 4) as stated by Strasburger.[1] Four cells lie in one plane (fig. 4a), making eight cells in the entire neck. At the stage of development represented in fig. 4 the ventral canal cell had not yet been cut off. A very large nucleus lay just beneath the neck while the remainder of the cavity of the archegonium was filled with granular protoplasm staining deeply with alum cochineal and containing many large vacuoles. In figs. 1 and 2 (Tsuga) the archegonium is mature, the ventral canal cell consisting almost entirely of a very large nucleus. The nucleus of the egg-cell occupied a central position. As regards other details in the development of the archegonium, I find them to agree with the account of Strasburger.

Apical growth of the stem.

In the BOTANICAL GAZETTE for January, 1892, Conway MacMillan, in a review of the work of Duliot on apical areas in seed plants, reports that author as concluding that in the gymnosperms the apical growth in the stem proceeds from a single apical cell. Unfortunately I have not had access to Duliot's paper, and do not know what species were studied; but from my investigation upon the stem of Pinus sylvestris the conclusion of Duliot seems to be very hasty at least. The growth in Pinus sylvestris corresponds very nearly with Strasburger's account for *Pinus Pumilio.*[2] A pretty well defined dermatogen layer passes over the entire apex which is relatively very large and cone-shaped at the period of active growth. The dermatogen is sharply defined from the periblem (fig. 5, *pb.*); so also the definition between periblem and plerome is very distinct (fig 5, *pl.*). At the extreme apex, however, the dermatogen cells are very much larger than the others, with very large nuclei. These *(x, x')* I take to be the initial cells. In this specific instance the dermatogen, periblem and plerome can all be traced to one or two large cells at the apex. This condition of things appears in three or four consecutive sections, though with not such great regu-

[1] l. c., p. 13.
[2] Die Coniferen und die Gnetaceen, pp. 327, 328. (1872.)

larity, showing that the apex is relatively broad. Transverse sections taken from the extreme tip show that it terminates in two or three large cells (figs. 6, 7), and it seems to me that we can not say with certainty that there is only one initial cell. Figs. 6 and 7 are consecutive transverse sections taken from the apex. In fig. 7 we have a near approach to what would lead one to regard the large cell, *x*, which has apparently just cut off a segment, *x''*, as the initial cell, both from its size and regularity in the arrangement of the cells about it. Yet this does not seem sufficient proof to warrant the conclusion. Fig. 5 is the only instance in which I found such great regularity; in all others the apex terminated in two or three large cells, which may be regarded as initial cells, but all approached nearly that shown in fig. 3.

In the apex of the stem of the embryo taken from the seed of Pinus sylvestris and Tsuga Canadensis, we find the nearest approach to a single apical cell (figs. 8, 9 and 10). It is quite probable that in the young state growth takes place from a single apical cell. In instances like that of fig. 8 this seems quite certain. In the embryo of Tsuga (fig. 10) this also seems to be the case, but in fig. 9 we can not be so positive as to the initial cell. A transverse section from the tip of the stem in a similar embryo shows two or three cells of uniform size (fig. 11).

In view of these facts it seems to me that we can not say that there is a single cell at the apex of the stem of the species under consideration, unless it be in the stem of the young plant, and even then not with absolute certainty.

All material used in this study was hardened in chromic acid (1 per cent.), thoroughly washed, stained *in toto* with alum cochineal or alum carmine, washed and dehydrated; then brought gradually into a saturated solution of xylol and paraffine, then into melted paraffine, imbedded and sectioned with a Minot microtome. The sections were counter-stained on the slide with Bismarck brown.

Indiana University, Bloomington.

EXPLANATION OF PLATE VIII.—Figs. 1, 2 and 3, longitudinal sections showing neck of archegonium of *Tsuga Canadensis; vc*, ventral canal cell. Fig. 4, same of *Pinus sylvestris; 4 a*, transverse section through the neck of archegonium of P. sylvestris. Fig. 5, longitudinal section through the apex of the stem of P. sylvestris; *pb*, periblem; *pl*, plerome. Figs. 6 and 7, consecutive transverse sections of the apex of the stem of P. sylvestris. Figs. 8 and 9, longitudinal sections of the apex of the embryo stem taken from the seed of P. sylvestris. Fig. 10, same of Tsuga Canadensis. Fig. 11, transverse section of the extreme apex of the stem of the embryo of P. sylvestris.

All magnified 175 diameters, except fig. 8, 150 diameters.

Germination of the teleutospores of Ravenelia cassiæcola.

B. M. DUGGAR.

(WITH PLATES IX AND X.)

As far as can be ascertained the publications relative to the morphology of the genus *Ravenelia* have yet given no idea of the germination of the teleutosporic stage. From results of anatomical studies in 1886, Parker[1] concludes that the structure of teleutospores is really that of a cluster of fused teleutosporic stalks. Cunningham[2] gives an interesting exposition of the development of the successive forms in two East Indian species, and also traces the development of teleutospores. He shows that the cysts are essentially modified basal cells of the true spore cells, and their origin is illustrated. He makes clearer the relation borne to other members of the group of Uredineæ. However, his attempts at artificial cultivation of teleutospores proved failures,[3] and he is not positive as to the success of experiments relative to the artificial infection.

In the biological laboratory of the Alabama Polytechnic Institute, and under the direction of Prof. Geo. F. Atkinson, artificial cultures have been made with some successful results. Inasmuch as the designation teleutospore involves the idea of the production of promycelia and sporidia, we can expect results to be only of generic importance.

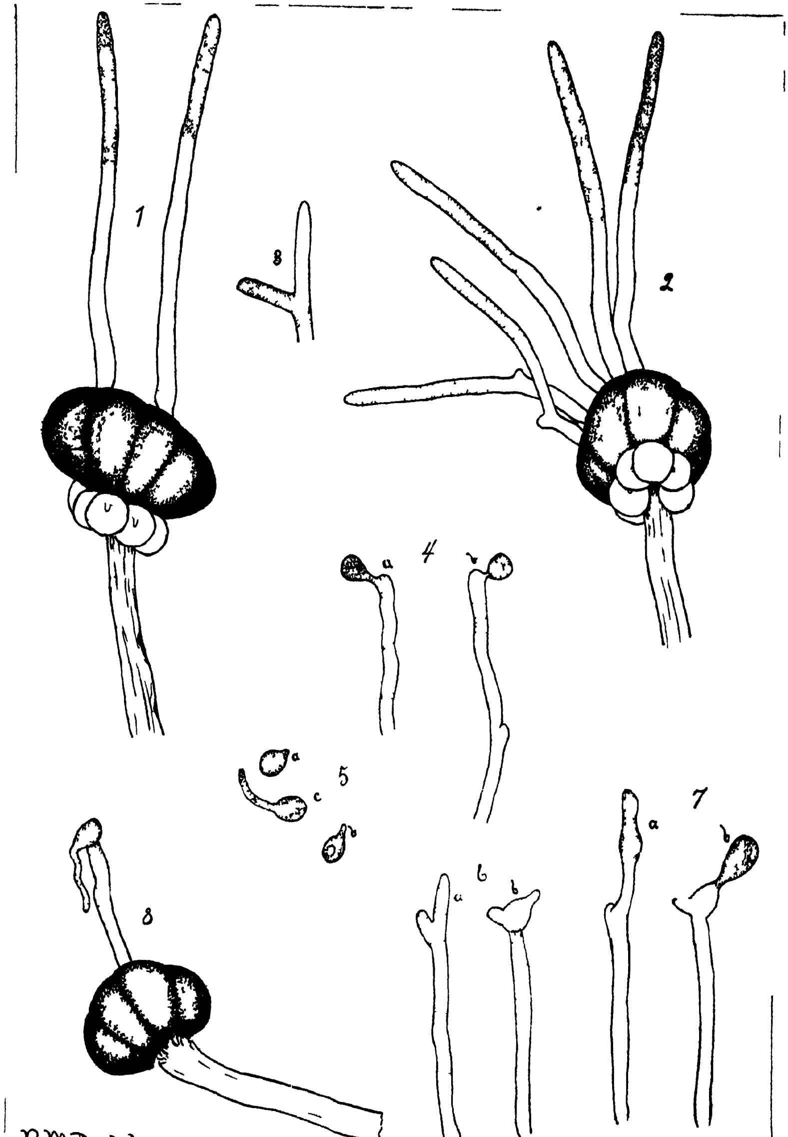
Since the genus is not as well known as its relatives, it may be well to observe some of the specific characters of *R. cassiæcola* Atkinson,[4] which I draw largely from the author's description. The teleutosporic form occurs most abundantly on the stems of the host plant, *Cassia nictitans*; yet it also attacks pods and leaves. The sori are usually irregularly oblong and very dark in color. The teleutospores are more or less brown, composed of from three to thirty somewhat wedge-shaped cells, the width of the head being usually from 50 to 90μ. The compound colored pedicel is from 10 to 18μ wide, and the length generally about 80μ, yet it may be twice

[1] Morphology of *Ravenelia glandulæformis*. Proc. Am. Acad. of Arts and Sci., vol. XXII.

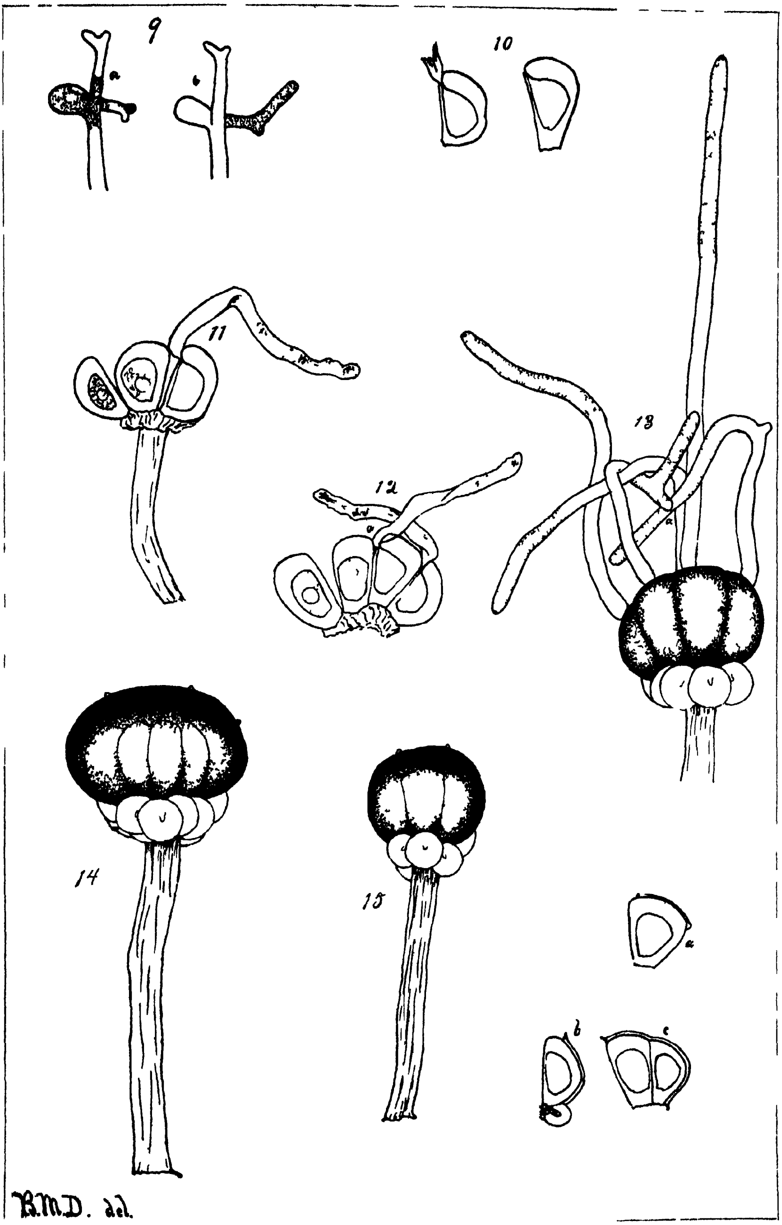
[2] Notes on the life history of *R. sessilis* B. and *R. stictica* B. & Br. Scientific Memoirs by Medical Officers of the Army of India.

[3] Cooke, Journ. Royal Mic. Soc., vol. III, p. 389, says: "The utmost that we have been able to accomplish has been to obtain single short germinating threads from the apices of a few of the pseudospores in *R. aculeifera*."

[4] Described in BOTANICAL GAZETTE, Nov., 1891, as "A new Ravenelia from Alabama."



DUGGAR on RAVENELIA



DUGGAR on RAVENELIA

as long. At the junction of the pedicel with the spore cells we observe the characteristic cyst cells. These are hyaline or slightly colored, usually spherical, and average about 12μ in diameter (for normal spores see figs. 14 and 15).

After remaining in water for some time, maceration of the spores is to a certain extent effected, and by slight pressure the individual cells are easily separable for examination. It is then apparent that *R. cassiæcola*, so far as the arrangement of cells is concerned, belongs to the division as noted by Parker of which *R. Indicà* is the type; consequently the cells are only laterally coherent. Besides the close union of adjacent cells, there is an external coat common to all which holds them together more firmly. In thickness, this is less than the exterior walls of individual cells (fig. 16), and from its surface often appear short, hyaline or slightly colored spines.

Specimens of the host plant containing the fungus in good condition were collected early in December, after the death of the vegetation. Water cultures, both slide and cell, then manifested no germination after being observed for a number of days. To continue the preservation of the material as in a natural state, it was simply "heeled in" under a box in an exposed place, and it was from this material that results were finally obtained. Slide and cell cultures with both distilled water and sugar solution were failures early in January, but on Feb. 23 the first results were secured. This occurred only in the sugar solution, and nine days after the spores had been sown. The results here given are from the same. It may be of interest to note that well-dried herbarium specimens have germinated after remaining three weeks in a cell culture with water.

The promycelia issue about perpendicularly to the plane of cells, bending towards the upper surface in an abundance of the medium, and when the spore lies on its side. Until a little greater than the length of the head, they are observed to be simple tubes completely filled with protoplasmic contents. These tubes rapidly elongate, the protoplasm collecting in the distal extremity, and they become finally from two to five times the length of the head (figs. 1 and 2). A promycelium may become branched, usually when meeting an obstruction to its growth, and this may be nearly at right angles to the former course (fig. 3). In all cases, however, the protoplasm remains separated only a short time, rapidly

collecting in the growing extremity. Apparent septa are sometimes observed (fig. 4 *a* and fig. 6 *a*), but the deception results from a coherence of granular contents in a cross section of the tube; and by moving towards the point of growth, this protoplasm soon mingles with the mass at the normal location (fig. 7 *a*). Variations of the above may be found in the empty spaces sometimes noticeable (fig. 13, *a*, etc.), and these are most abundant after a considerable growth has taken place. Small vacuoles are not infrequent.

The sporidia are developed at or very near the terminal portion of the promycelia (fig. 4, *a* and *b*). The first evidence of this formation is shown by a part of the protoplasm collecting into a side branch, whose connecting portion is but little smaller than the main tube, and which assumes more or less the usual characters of a sterigma. With this development of sporidia a more highly refractive power is manifest. A sporidium measures about 9 μ in diameter, but its form is not generally spherical. In most cases the abscised reproductive body shows a prolongation at the end by which it was attached (fig. 5 *a* and *b*), the constriction which eventually sets the body free encroaching somewhat on the usual limits of the sterigma in the group of Uredineæ. Vacuoles are frequently present, but these vary in number and in size.

Sporidia are not always produced, and their absence is counterbalanced by a longer growth of the tubes. This greater growth probably results from the fact that the promycelia are completely immersed in water. Lagerheim[5], speaking of the germination in water of *Puccinia heterogena* Lagerheim, says, "They then germinate exactly like uredospores; a long non-septate germ tube, often bent backward and forward, and with a strongly undulating contour, grows out of the germ pore. . . . Probably the fungus can reproduce itself by these germ tubes, which, because they form no sporidia, penetrate directly into the leaf." It is possible that under favorable conditions the same may be true for the long promycelial growths of the fungus we are considering. A promycelium often shows an enlargement at the end, as if a terminal sporidium were to be produced, but instead, the tube may be again normally continued. With the above character, a geniculation is often noticeable, the new growth

[5]Journal of Mycology, vol. VII, no. 1.

resulting in the protrusion of the wall in an oblique direction; or the latter character may exist independently of the former. A peculiar instance is shown in fig. 9, *a* and *b*, where a sporidium seems to be almost fully developed laterally, then its wall is protruded from near its base into a new tube which again branches. It seems that a promycelium bears only one of these reproductive bodies, as more than that number have not been observed; still this cannot now be positively asserted. The true development of the promycelia is often interfered with on account of parasitic attacks. Owing to the large size of the spores of this fungus, they carry many adhering germs into the cultures, and the tender promycelial tubes are favorite spots for bacterial growth. It appears that the germination of a sporidium is by the prolongation of the pedicel-like end of attachment (fig. 5, *c*).

If the cells of a germinating teleutospore are separated by gentle pressure under a cover glass, the emergence of the promycelia from the germ pores can be noted. In the peripheral cells, which are externally somewhat convex, the germ pore is situated at the upper and inner extremity (fig. 10), while in the more angular central cells it may be at any distal corner (fig. 12, *a*). In all cases it is marked by the junction of the thick external cell wall with the thinner wall separating individual cells. The germ pore can be more distinctly seen by the usual examination with sulphuric acid.

In Ravenelia cassiæcola only has the germination of teleutospores thus far been observed, but these notes serve to indicate that the germination is generically characteristic. It differs from that of such typical genera as Puccinia, etc., in the non-septate character of the promycelia, except in such species as P. heterogena above mentioned, where the germination takes place in an abundance of water. "In *Coleosporium*," says Plowright,[6] "each cell produces a single promycelial spore," and from his illustration of *C. senecionis* we observe that the tube which bears this sporidium tapers gradually to a very small size. Now if we deem both promycelium and sterigma essential terms, it is difficult to differentiate their limits in such cases. Sorauer[7] only states that each cell develops a simple promycelium with a sporidium. De Bary[8] defines

[6] British Uredineæ and Ustilagineæ, p. 45

[7] Pflanzenkrankheiten, 2te Aufl., II, p 244.

[8] Morphology and Biology of the Fungi, etc, p 281

the character of producing a single sporidium as peculiar to Coleosporium, but he names the entire tube from which this body is abscised a sterigma. Since the term sterigma is more or less broad, we may regard *Coleosporium* as possessing a truly non-septate promycelium, and still the above details will perhaps make clear the essential modifications in R. cassiæcola and probably the general features in the germination of the genus Ravenelia.

Polytechnic Institute, Auburn, Ala.

Explanation of Plates IX and X.

Plate IX.—Fig. 1, germinating teleutospore, showing normal condition of promycelium. Fig. 2, same as above with a slight geniculation and rudimentary branching. Fig. 3, a promycelial branch almost at right angles to the former course. Fig. 4, *a* and *b*, stages in the development of sporidia; *a* also shows apparent septa. Fig. 5, *a* and *b*, sporidia; *c*, sporidium germinating. Fig. 6, *a* and *b*, abnormal conditions of promycelia. Fig. 7, *a* and *b*, same as fig. 6, but representing appearances on following day. Fig. 8, teleutospore with single promycelium and abscised sporidium germinating while still in the vicinity of its point of production.

Plate X.—Fig. 9, *a* and *b*, peculiar development of a promycelium noted on successive days. Figs. 10, 11 and 12, representing cells separated by pressure, and showing the location of the germ pores and the emergence of the promycelia. Fig 13, teleutospore germinating, but so surrounded by other spores that the promycelia are modified. Figs. 14 and 15, normal teleutospores of different number of cells Figs. 16, *a*, *b* and *c*, individual cells, showing relative thickness of cell walls and the common external coat.

All figures were drawn under camera lucida.

Notes on Carex. XVI.

L. H. BAILEY.

An unusual amount of carex material has come into my hands within the last year, bringing a number of new species, extending the ranges of well known species to an important extent, and affording data for the clearing up of old doubts. These specimens have come from almost every part of North America and from very many collectors; in fact, the carex flora of the country has never had so many friends as at present. Some of the most important facts concerning the geographical distribution of species are recorded below.

Carex obesa All., var. *minor* Boott, heretofore not known south of Saskatchewan, was collected last July upon high bluffs at South Fowl Lake, Northern Minnesota, by F. F. Wood.

C. Torreyi, the rarest of the eastern carices, was found in abundance upon a small area in 1890, in the suburbs of Minneapolis, by J. H. Sandberg. This species was reported from New York and Pennsylvania a half century ago, but has never been rediscovered within Gray's Manual region until the present finding. It occurs in Colorado and in British America, and its reference to New York and Pennsylvania is probably an error. The original specimens were found in a European herbarium mixed with *C. pallescens* from New York and Carlton House, British America.

C. Tuckermani, reported no farther east than western New England, has been found at Kineo, Moosehead Lake, Maine, by Dr. G G. Kennedy.

C. chordorhiza, not known east of Vermont heretofore, is sent from Orono, Maine, by M. L. Fernald.

C. laxiflora var. *divaricata* has been collected at Natural Bridge, Virginia, by J. R. Churchill.

C. hystricina var. *Dudleyi* was found growing quite abundantly in a low place at Owosso, Michigan, by G. H. Hicks. This is the fourth station for the plant.

C. cephaloidea, not known east of western Massachusetts, where Dewey first found it, is now found in York Co., New Brunswick, by Mr. Brittain.

C. trichocarpa var. *Deweyi*, is sent from Ames, Iowa, by Professor A. S. Hitchcock. It has been known in the Manual region only from Dakota.

C. distans Linn., a European species, was found in ballast in Philadelphia, in 1877 and 1884, by I. C. Martindale, Mr. Martindale also found at Atco, N. J., in 1876, the true *C. flava* var. *Œderi* Lilj. This is the only finding of this plant in America, so far as I know. *C. panicea* is sent from Sellersville, Penn., by C. D. Fretz. This species, while very thoroughly established in some parts of Massachusetts, does not appear to extend itself rapidly into new regions.

Since the separation and proper delineation of *C. deflexa* and *C. Novæ-Angliæ*, these species have been sought and they are found to be more frequent than the Manual record indicates. *C. deflexa* is not confined to "high mountains," having even been found in a low sandy pasture on the banks of Great Works River, S. Maine, by John C. Parlin. It is also sent from the Keweenaw peninsula, Northern Michigan, by O. A. Farwell. *C. Novæ-Angliæ* is frequent at Mt. Desert, and

Edwin Faxon sends a fine suite of specimens from the White Mountains: from Profile Lake and Bald Mt., Franconia Notch; White Mt. Notch near Willey House; woodland cleared of trees, between Fabyan's and base of Mt. Washington; summit of Mt. Willard. It is strange that this well marked species should have been so long overlooked.

Three species are added to the Manual region from Nebraska: *C. Nebraskensis* Dewey, from Anselmo, Custer Co., and Hot Creek Basin, Sioux Co., by H. J. Webber. This is the first time the species has been found within the present limits of Nebraska. *C. Douglasii* Boott, Anselmo, Custer Co., Webber. *C. marcida* Boott, Anselmo and Broken Bow, Custer Co., and Thedford, Thomas Co., Webber; Alliance, Box Butte Co., G. D. Swezey.

C. canescens var. *dubia* Bailey, which has been one of the most obscure forms of a perplexing species and which has been known only from one collection in the Uintah Mountains and another in the Wahsatch, is now represented in my herbarium by good specimens from the Blue Mts. of Eastern Oregon (Cusick), Skamania Co., Washington (Suksdorf), and Tulare Co., Cal. (Coville, 1506 Death Valley Expedition). It proves to be well defined.

Among the novelties, the following appear to be supported by sufficient evidence:

C. herbariorum n. sp.—One of the FERRUGINEÆ allied to *C. ablata* and *C. luzulæfolia*: tall and slender (2 ft. or more?), smooth throughout; leaves broad ($\frac{1}{4}$ or $\frac{3}{8}$ in.), thick and stiff and apparently half evergreen, long; staminate spike single, an inch or two long, on a stalk of about its own length, rusty, the scales nearly linear and pointed; pistillate spikes 3 or 4, approximated near the top of the culm, erect, an inch or so long, evenly cylindrical, rather loosely flowered, rusty, on stalks once or twice their own length and springing from loose sheaths about an inch long which are tipped with an awn-like projection of similar length; perigynium medium or below in size, lanceolate, prominently excurved at maturity, strongly nerved and 2-toothed, smooth, about the length of the ovate and pointed brown-margined scale.—A well marked species with perigynia reminding one of the interesting VIGNEASTRÆ section. Habitat unknown. The species was found in a miscellaneous batch of nondescript carices from Herb. Olney (Brown University), without date, locality or

collector. Since the determination of the species, James L. Bennett, of Brown University, writes that the plant was collected by Wheeler's Expedition West of the 100th Meridian. In Wm. Boott's report upon the carices of this expedition there is nothing to suggest this species.

C. Pringlei n. sp.—One of the PALUDOSÆ, not closely allied to any American species, but coming nearest, perhaps, to *C. riparia:* tall, stiff and stout (four to six feet high), pale throughout, the culm obtusely angled and smooth; leaves stiff and long, rough on the edges and sometimes on the keel; staminate spikes three or four, an inch or two long or the terminal one twice longer, cylindrical, scarcely stalked, the bases enveloped by a scarious bract, the scales of the spikes linear and membranaceous with a somewhat expanded tip which is more or less jagged and provided with a short cusp; pistillate spikes three to six, all approximated or aggregated, heavy and densely flowered, two to four inches long, sessile and erect, their bases subtended by an expanded and long-pointed bract; perigynium long-linear-elliptic or linear-ovate (about four lines long), thin and flat, the small and stipitate three-angled achenium lying nearly in the center, faintly few nerved, beakless, the orifice entire or slightly sulcate, the lower portion smooth, but the upper part sparsely hairy, about the length of or slightly shorter than the strong-pointed or even awned rough scale.—A coarse bushy-spiked species with something the look of *C. spissa;* collected August 4, 1891, on borders of pools and streams in alkaline meadows one hundred miles east of the city of San Luis Potosi (Hacienda de Angustura), Mexico, by C. G. Pringle (No. 3801).

C. xerantica n. sp.—Group OVALES, between *C. pratensis* and *C. fœnea*: differs from the above species in its short erect silvery-white head, and broader, much firmer and nerveless perigynium. It is a tall and very stiff species with a straminea-like aspect, and dry appearance. It was collected at File Hills, British America (104° longitude, and 50½° latitude), by John Macoun, July 4, 1879, and at Moose Jaw, about thirty miles west and forty south of File Hills, by the same collector July 18, 1880, in both of which stations it was rather abundant. I have endeavored for a number of years to refer this perplexing plant to some of its neighboring species, but the attempt is always unsatisfactory. Its characters are constant in a good suite of specimens, and it appears to merit specific distinction.

C. Montanensis n. sp.—Belongs to the RIGIDÆ and is allied to *C. Tolmiei*, although it has much the habit of the PENDULINÆ (as *C. Magellanica*): a foot or a foot and a half high, in tough clumps, the culms weak at the top and mostly nodding, somewhat overtoping the flat and rather soft narrow (1½ to 3 lines wide) leaves; staminate spike single, about a half inch or less long, ovate or ovate elliptic, brown-purple, on a short and weak stalk, the scales thin and mostly blunt; pistillate spikes three to five, borne at the top of the culm and drooping or nodding on slender stalks, from one-half to three-fourths of an inch long, dark colored, the lowest bract leafy and about equalling the culm; perigynium ovate, soft, nerveless (entirely lacking in the granulated character of *C. Magellanica* and its allies), terminated by a short and very slightly toothed beak about the length of but broader than the black-purple blunt scale; stigmas two or three.—Montana, Upper Marais Pass, W. M. Canby, Aug. 2, 1883 (no. 350), and along subalpine streams, Park County, Frank Tweedy, Aug. 5, 1887. Also on mountain slopes, Kootanie Pass, Rocky Mountains of British America, John Macoun, Aug. 9, 1883. I have at different times referred this plant to *C. atrata* var. *ovata* and *C. Tolmiei*.

C. bella n. sp. (*C. atrata* var. *discolor* Bailey).—This beautiful plant appears to have no immediate connection with *C. atrata*, and when I first referred it to a variety of that species I thought that "it is not improbable that it is specifically distinct from *C. atrata*" (Journ. Bot., Nov. 1888). It is more closely allied to *C. Mertensii*. It is a slender plant, about two feet high, the culms surpassing the flat and long pointed leaves; spikes 3 or 4, the terminal one prominently staminate below and the others usually bearing more or less staminate flowers at the base, all approximated, the lowest one or two drooping on very slender peduncles and the upper ones sessile or nearly so, all narrowly cylindrical (about 1 in. long), compactly flowered, the whitish perigynia contrasting forcibly with the purple scales; perigynium ovate, whitish, thin and somewhat inflated, nerveless, abruptly contracted into a very small straight beak which is very lightly toothed or simply erose, much broader and mostly a little longer than the purple sharp pointed scale.—Mountains, Colorado, Utah, and Arizona.

C. varia Muhl. var. **australis** n. var.—Stoloniferous; spikes all distinct or at least not aggregated, the lowest one often entirely separated from the rest, all usually longer than in the species itself; staminate spike straight and conspicuous. Tupelo and Starkville, Mississippi, Tracy; Houston, Texas, Nealley; and Hockley, Harris Co., Texas, Thurow.

C. aquatilis × stricta. A pronounced hybrid between these species has been found in some quantity at Orono, Maine, by M. L. Fernald. The hybrid is fully as vigorous as *C. aquatilis*, and is glaucous, but the perigynia and scales are stricta-like, although the spikes are large and thick, as in *C. aquatilis*.

Material wanted.—A carex which is said to produce good pasturage is reported to grow in Louisiana, but I have not been able to secure good specimens of it. I have obtained a bunch of the dry leaves and some loose perigynia from a correspondent in Grant Parish, central Louisiana, and I am not able to place the specimens with any species. It appears to be undescribed. My correspondent writes me as follows: "The plant grows here in the forest upon alluvial lands upon certain portions of the Red River bottoms. Near me are 500 or 600 acres covered with it upon which numbers of cattle and horses winter. It grows as thick as any grass, and not in bunches here and there, making a perfectly green and firm covering four to eight inches high." Unfortunately, my correspondent is not a botanist, and an expert witness is wanted to determine if all this pasturage is really a carex; and I desire good specimens of the plant for determination.

Our common *Carex echinata*, with its varieties, is in need of revision, and I shall be glad of any specimens which will throw light upon its variations.

Cornell University, Ithaca, N. Y.

An automatic device, for rolling culture tubes of nutrient agar agar.

GEO. F. ATKINSON.

(WITH PLATE XI.)

Rolled culture tubes of nutrient agar agar are so convenient for the separation of many micro-organisms, and are employed by so many investigators for the study of the growth and conformation of colonies that any device for rolling them successfully is worthy of note. Especially is this the case when such device is, under certain circumstances at least, an improvement over the present methods in use.

The device introduced by Esmarch of spinning the tubes on the surface of ice water while a rubber cap covered the cotton plug was improved upon by Dr. Booker, of Johns Hopkins University by spinning them in a groove upon a block of ice.[1] This is an exceedingly satisfactory method. There is one difficulty encountered, however, which in many cases varies from a trifling to a very serious matter, according as ice is obtained with comparative ease or great difficulty. Those who are fortunate enough to be located in centers where trade demands for ice provide a constant supply, encounter simply a trifling expense and the little attention necessary to obtain the supply needed. Many institutions and workers, however, are so situated that it is almost impossible during the winter months to obtain ice without going to great expense, and many times during any season of the year the trouble alone of providing it is no small annoyance.

Being so situated myself I have given my attention to devising some means of rolling the tubes with precision by making use of the water supply commonly provided for in laboratory fittings. It is possible with a stream of cold water from a faucet to so hold with the hands and revolve a tube as to distribute and fix the nutrient agar in a thin and tolerably even film. But many failures result and at best the tube is far inferior to one rolled on ice.

Recently I have made an automatic device for rolling the tubes under a continuous shower of cold water as perfectly and regularly as it is possible to do on ice and with far less trouble even though a constant supply of ice is within easy reach.

[1] Mead Bolton: Schizomycetes, etc. Reference Handbook of Medical Sciences, vol. VI.

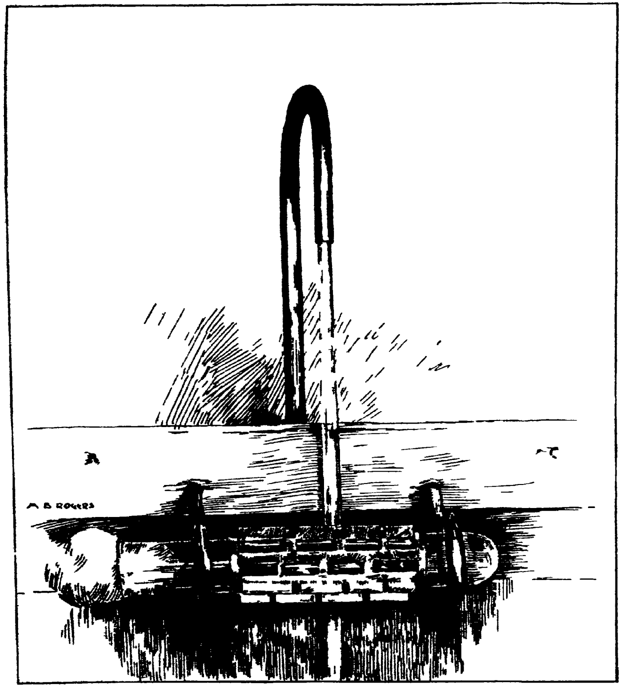


FIGURE 2.—Culture tube at rest

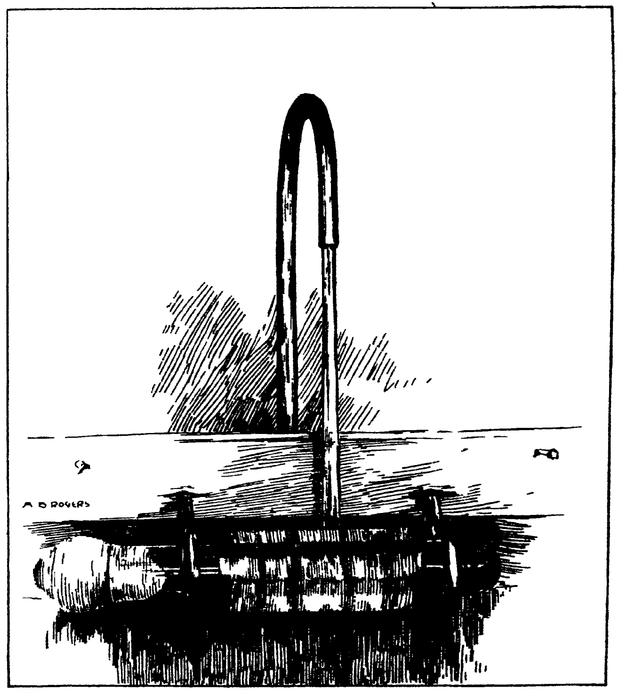


FIGURE 3.—Culture tube in motion

ATKINSON on a DEVICE FOR ROLLING CULTURE TUBES

It consists of a tin jacket, with rectangular perforations and bristling with "paddles," which grasps the tube and upon which the stream of water is so directed that it furnishes not only the motive power for whirling the tube but also the cold bath to solidify the agar agar. This device, quiet and in motion, is shown in figures 2 and 3 in plate XI.

The jacket I made in about an hour's time. It is quickly and easily slipped from one tube to another. The frame work which rests across the edges of the sink and holds the supports for the tube was the work of a few moments. The

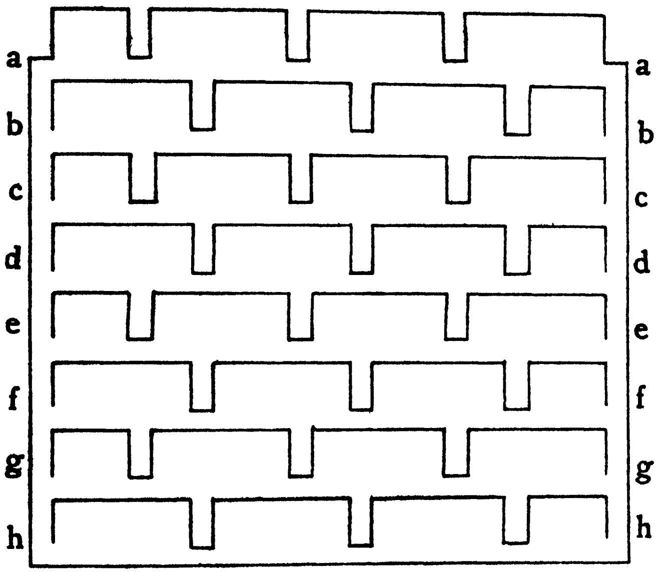


FIGURE 1.—Outline of jacket for rolling culture tubes. Full size.

jacket was made from a single piece of tin as follows: The tin was first cut the exact size of figure 1, three edges being straight while one edge was cut as shown in the figure. Now placing the sheet of tin upon a block of wood, with a quite narrow sharp chisel cuts were made corresponding to the irregular lines *b b*, *c c*, etc. The sheet was then placed in a vise down to *a a*, and the four rectangular projections bent perpendicularly to the sheet in the same direction that the chisel was driven. The sheet is then raised to the line *b b*, and so on until all the small rectangular pieces are bent out to

serve as paddles; the spaces serve to admit the water upon the tube.

The sheet is now bent around a cylinder of a somewhat less diameter than the test tubes to be used. This gives the jacket a tension which enables it to grasp the tube firmly. By erecting the paddles in a direction corresponding to the cut of the chisel, the inner surface of the jacket is left smooth and does not scratch the glass in slipping it on or off.

For the support of the tube while under the shower bath I used two ceiling hooks which I screwed into a narrow board long enough to rest across the sink. They should be so levelled that the end of the tube containing the cotton plug will be very slightly elevated. The rapid motion will prevent the agar from gravitating down the tube while water will not run on to the plug.

In rolling the tubes the frame is drawn a trifle forward so that the stream of water passes in front of the frame, but just behind where the tube will rest. So soon as the tube is lifted from the warm water bath the jacket is slipped on, the tube then held horizontally, while the liquid agar is first distributed evenly in the usual way. Place it immediately on the supports as shown in figure 2, plate XI, then quickly slide the frame backward so that the water strikes the paddles when the tube immediately revolves as shown in figure 3, plate XI. The supports must not pinch the tube in the least else the friction will interfere with the freedom of the revolutions. The jacket and frame when not in use should be kept dry to prevent rust.

A little practice will determine the proper distance for the jacket from the end of the tube. It is best to have it a little nearer the bottom end of the tube and to allow the stream of water also to strike somewhat nearer the corresponding end of the jacket. This lessens the danger of wetting the cotton plug. As I have arranged mine, when running very rapidly the plug is kept dry.

In making the jacket due regard should be had for the size of the tube to be rolled. Within certain limits tubes of different diameters can be rolled with the same jacket since its elasticity permits some variation in its accommodation to the tube.

Alabama Polytechnic Institute, Auburn.

Noteworthy anatomical and physiological researches.

Gases in massive organs[1].

While this paper does not contribute very much that is new it is interesting as a careful record of experiment and as a verification of earlier researches. The author has availed himself of the more recent method of gas-analysis and brings out some interesting points, particularly regarding the pressure of internal atmospheres in plant-organs. In general his method is to produce an artificial chamber by perforating the fruit or tuber or root to be observed and in the *lacuna artificielle* thus produced to insert a tube, with the lower end sunk in a mercury-bath from the upper portion of which tube, as needed, a little gas can be taken for analysis. In this way it is possible to have under one's eye the changes that may take place and the differences, if any exist, between the internal and the external air are clearly distinguished. Potato-tubers and several fleshy fruits, those of various gourds and Rosaceæ, were studied with much care and an effort was made to discover not only the nature and pressure of the inclosed gases but to determine in what way these gases were distributed through the tissues, whether by diffusion, effusion (the movement through small channels) or by dialysis through membranes. Some of the general conclusions may be briefly transcribed here to indicate better the scope and extent of the researches.

1. The internal atmosphere of fleshy or massive organs is generally marked by a notable increase over the surrounding air in the proportion of oxygen, a feeble proportion of CO_2 and a slightly different proportion of nitrogen, which sometimes exceeds that in the outer air and sometimes does not, but is always rather close and slow to vary. 2. The internal pressure is almost always different from that of the outer air. Sometimes it is negative and sometimes positive but always in inverse proportion to the nitrogen. 3. The oxygen tends to be distributed through pores (effusion), but the CO_2 tends to be distributed through membranes (dialysis). 4. Humidity acts upon a massive organ in such a way as to increase its permeability while diminishing its porosity, and this is reflected in the changes in the pressure and composition of the internal gases. It tends therefore to a purifying of the air, in most cases, by the accumulation of oxygen and the throw-

[1] H. Devaux :—Ann. Sci. Nat. Botan., Ser. VII, XIV, 297–395.

ing off of CO_2. 5. Dessication acts in the reverse manner and, by diminishing the permeability, decreases the oxygen and tends to the storing up of a greater proportion of CO_2. 6. The nitrogen is passive and is carried as a by-product with the others. 7. The general conditions of gaseous interchange between fleshy plant structures and the rest of the plant or the outer air are best understood when we fix our attention upon the undoubted fact that there are three different kinds of interchange going on simultaneously, each of which is capable of modification by external or internal conditions. These are diffusion, effusion and dialysis.—CONWAY MACMILLAN.

Effects of electricity on growth.[1]

In this paper Hegler has described the effects of electricity on the growth of plants. In it he has shown that certain plants respond to electrical stimuli in a similar manner as they do to light. In his experiments he used an apparatus like that used by Hertz. Hertz has already demonstrated that electricity presents quite the same phenomena as light; that the electric beam can be polarized, focused, reflected and refracted.

The apparatus consists briefly of four Bunsen elements, which are connected by an interrupter with a very large induction apparatus, consisting of many thousand feet of coil; from this the current is transmitted to two brass knobs of 1.5 cm. radii, which constitute the poles, and between which the electric spark is made to pass at regular intervals. The brass knobs are placed about 10 cm. apart in a vertical direction, so that the transverse electrical waves fall on the long axis of the plant which is situated 1–2 cm. from the electric spark.

For these experiments Hegler found the rapidly growing aerial hyphæ of *Phycomyces nitens* particularly well adapted, as it is well known that they are exceedingly sensitive to all external influences. The plants were cultivated on sterilized bread and covered with a black paper cylinder to prevent heliotropic bendings. He found in from 3 to 6 hours the hyphæ bend away from the electric source, from which he maintains they are negatively electrotropic. The angle of bending, however, he found somewhat smaller than that produced by intense light. Herr Hegler also experimented with reflected rays, both from a plain and parabolic metal reflector, from which he obtained similar results.

---

[1] ROBERT HEGLER:—Ueber die physiologische Wirkung der Hertz'schen Electricitsetszellen auf Pflanzen Leipzig.

When a cylindrical wire gauze was placed over the plant the hyphæ made no bendings, although a bell glass made no difference at all in their response to the electrical stimulation. —GEO. E. STONE.

The vegetation of the paramos of Venezuela.[1]

This paper contains a general sketch of the vegetation of the paramos with reference to the distribution and appearance of certain plants, and an account of the biology of these xerophilous plants.

Some of the Compositæ are characteristic of the paramo vegetation. Transpiration is diminished in these plants in different ways; for instance, by a dense cover of woolly hairs, by the development of coriaceous leaves, sometimes small in size and with involute margins, or by the development of merely short stems with densely leaved rosettes and underground reservoirs of nutritive matters. These characters are not, however, strictly separated, for more than one may be observed upon the same plant. Several other families besides the Compositæ show the same peculiarities.

The leaves of *Espeletia* have an immense cover of long white hairs, which are bent into broad spirals, so as to form a layer many times thicker than the leaf-blade itself. Thus the plant is well protected against a too rapid change in temperature, against the exsiccating effect of the winds, and has at the same time gained control of the transpiration. The leaf has a distinct hypoderm, which probably serves as a water-reservoir, and the inferior face shows several longitudinal ribs, which border on corresponding cavities in the leaf-blade. The chlorophyll-bearing parenchyma covers the furrows between the ribs, and there are in the interior part of the leaf wide openings, which remind us of lacunes, but which are covered with hairs and provided with stomata. These openings have been formed merely by a turning inwards of the surface of the leaf-blade. Of other paramo-plants with similar covering of hairs are mentioned a *Plantago*, a *Lupinus*, and especially the remarkable *Jamesonia nivea*. This last shows an aspect widely different from other ferns; the pinnules are horizontally spread out and cover each other as closely as the coins in a roll.

[1] K. GOEBEL:—Die Vegetation der venezolanischen Paramos Pflanzenbiologische Schilderungen, Pars 2 Marburg 1891

Protection secured by diminishing the leaf surface is especially marked in a grass, *Aciachne pulvinata.* The blade is so strongly involute that the stomatiferous superior face is a mere furrow. The cells of the inferior epidermis are very thick walled and there are three layers of sclerenchyma inside the epidermis, all around the blade.

In some other plants the leaves are awl-shaped with the aspect of conifers or lycopods; such forms were observed in *Hedyotis nitida* HBK., which belongs to the Rubiaceæ; in *Lysipomia* of the Lobeliaceæ; and in *Phyllactis* of the Valerianaceæ; in species of *Alchemilla* and others.

There are, however, other peculiar forms of paramo-plants, which can not be arranged under any of the three above named groups; for instance some Umbelliferæ with leaves like those of a *Juncus*, namely *Ottoa*, *Crantzia*, etc.

Although these paramo-plants show the so-called xerophilous structure, the author calls attention to the fact, that a similar structure is also known in plants which do not belong there, but inhabit widely different localities. We therefore cannot always depend too much on structure in determining the character of the locality, because anatomical structure in this instance merely shows that the individuals live in a climate where a protection against transpiration has become necessary. This special vegetation seems to have been forced into its present shape for defence against stormy winds rather than extreme heat.—THEO. HOLM.

BRIEFER ARTICLES.

The identity of Asclepias stenophylla and Acerates auriculata.—(See p. 124 *ante.*) Correction must be made regarding the name recognized. There is an *Asclepias auriculata* Kunth. So Engelmann's *Asclepias auriculata* is not tenable. Dr. Gray's name, *Asclepias stenophylla*, must therefore stand. I hasten to make this correction, the more since I hesitated at the time in following the dictum that "the oldest available specific name" must stand. It seems to me, from this present experience, that to take up "the oldest available specific name *in the right genus*" is safer and less liable to reconsideration.—J. M. HOLZINGER, *Washington D. C.*

The embryo-sac of the Metaspermæ.—Hartog in the Dec. 1891 number of the *Quarterly Journal of Microscopical Science* suggests that the eight cells in the embryo-sac of the Metaspermæ are all to be considered as reproductive and follows the later view that the endosperm nucleus is a zygote. In a foot-note he retracts this position, in consequence of Guignard's work on the embryo-sac of *Lilium*. The writer a short time ago sent to the GAZETTE a statement of the same position as that first maintained by Hartog; but upon seeing his paper the preliminary note was withdrawn. In view of my own observation I am not, however, inclined to withdraw with Hartog from what seems to me the clear fact that the embryo-sac is, wherever we meet it, a *megaspore*. I do not think that the results of Guignard at all prevent us from holding to the view that the cells within the embryo-sac are, in Archispermæ and Metaspermæ alike, a female plant. At a later time I hope to discuss this point. In this brief note attention is directed to one fact which has escaped the late investigations, I believe. It is this: in the embryo-sacs of *Narcissus poeticus*, *Portulaca oleracea*, and *Cucurbita pepo* the micropylar nucleus, that is the sister nucleus of the egg, stains as does the *sperm* nucleus from the pollen-tube of the same species. The antipodal nucleus that fuses with this micropylar nucleus to form the definitive nucleus stains as an *egg*. That is to say, the micropylar nucleus stains about twice as quickly as the antipodal in both methyl-green and safranin. It has numerous, deeply stained chromatin bodies (chromosomes or chromatomeres) and the nucleoli are of a greater number than in the antipodal nucleus. In a number of other ways that might be named the antipodal nucleus reacts as an egg while the micropylar nucleus reacts as a sperm. It is clear that this can be explained either upon the hypothesis of Weissmann that the micropylar nucleus is histogenic, upon that of Hartog that it is an arrested gamete, or, best of all, upon that of Minot, Balfour and Van Beneden, that it is the male substance thrown off as a polar body and to make room for the similar but more distant substance of the sperm-nucleus. It is therefore improper to say as Hartog does that the definitive nucleus is a zygote, for there is a clear morphological distinction (that of size), beside the physiological one given, between the two fusing nuclei. Undoubtedly this fusion is a sexual act and the antipodal nucleus after it has been fertilised is enabled to pass into the segmentation phase and actually builds up a body, the endosperm, which is, however, always dependently situated with regard to the more virile, cross fertilised, embryo-producing egg-cell. The views of Warming, Mann,[1] Vesque, and Guignard, or the later view of Hartog, that these cells are any or

[1] See BOT. GAZETTE, this vol., p. 104.

all of them spores or the homologues of spores, seem to draw little support from the fact recorded. It is well said though by Hartog that the whole eight-cell group should be considered as egg-organs and not in any part as prothallium. I made this point in the note that was withdrawn, from a consideration of the staining phenomena mentioned above, and it seems not unlikely that it will be supported. It is very evident that the endosperm of the Metaspermæ is a different structure from that of the Archispermæ. It is probable that the two types are to be referred to different generations, that of the Archispermæ to the gametophytic and that of the Metaspermæ to the sporophytic.—CONWAY MACMILLAN, *University of Minnesota.*

A bit of the flora of Central Arizona.—During July and August of last year I was collecting plants and studying the flora of Central Arizona. While *en route* for Camp Verde by the old Black Cañon stage route between Phœnix and Prescott, I stopped for two days at Big Bug. This is a small mining camp and stage station some eighty miles north of Phœnix. During my sojourn here, I found in a deep cañon several miles northwest of the station as interesting a bit of flora as I have seen since coming to the territory.

As we leave the flat sandy desert, which extends for some distance north of Phœnix, and enter the mountainous region, there is almost an entire change in the floral aspect of the country. At this season of the year the only conspicuous vegetation on the sandy mesa that could be observed from the top of the stage coach were several species of cacti and the creosote bush, Larea Mexicana Moric. This shrub grows in nearly all parts of Southern Arizona, and is perfectly at home upon the driest mesa, where, in some years, it is without rain for several continuous months. It has surface roots and frequently grows upon a hard, rocky subsoil. No doubt the gum which covers the leaves like a coat of varnish aids greatly in retarding the evaporation of moisture.

Of the species of cacti found here, Cereus giganteus Engelm., Echinocactus Wislizeni Engelm., and the great tree cactus, Opuntia arborescens Engelm., are the first to catch the traveller's eye.

There is a marked variation in the forms of this latter species as found in the various parts of the territory. This variation is noticeable in length of spines, relative length of joints, color, and in the general aspect of the plant. It is possible that some of these forms may constitute varietal differences, or even specific ones, under more extended study.

As we reached the mountains, our route brought us to the Agua Fria River, which in July was almost dry. The banks of this stream,

together with its tributaries, were in many places covered with large clumps of Prunus demissa Wal. and Rhamnus Californica Esch., with now and then a large cottonwood or black willow showing above them. Platanus racemosa Nutt., Fraxinus pistaciæfolia Torr., and Juglans Californica Watson, were frequently seen nearly covered with the long and heavy vines of Vitis Arizonica Engelm., which grows in great abundance in nearly all the valleys of the territory. In many places the river bed was a complete tangle of Fallugia paradoxa Endlicher, Baccharis glutinosa Pers. and Baccharis salicina T. & G., while in the open places Petunia parviflora Juss., Chamæsaracha coronopus Gray, Euphorbia polycarpa Benth. var. aristida Watson, Euphorbia serpyllifolia Pers., Euphorbia albomarginata T. & G., Croton Texensis, Müll., Polanisia trachysperma T. & G. and Gaura parviflora Dougl., sprang up between the stones or out of the clear white sand. Extending back to the mountains on each side of the river was a dense chapparal of several varieties of Quercus undulatus Torr., densely loaded with acorns. In some localities these shrub oaks fruit so profusely that swine ranches are maintained upon the acorns alone. Mixed in with these oaks were found Arctostaphylos tomentosa, Dougl., Arctostaphylos Nevadensis Gray, Arctostaphylos pungens HBK., Acacia Greggii Gray, and Zizyphus lycioides Gray; while underneath them were growing Hedeoma Drummondii Benth., Verbena ciliata Benth., Mentzelia Wrightii Gray, and several species of Eriogonum. An Opuntia was occasionally seen, while here and there a Yucca baccata Torr. extended its long filamentous leaves in all directions, or an Agave Parryi Engelm. projected its scape high in the air. A few straggling spears of grass were found, mostly Bouteloua racemosa Lag. and Muhlenbergia Texana Thur. with a frequent bunch of Hilaria rigida Scrib. At this season the annuals were mostly scorched and destroyed by the prolonged drouth.

Traveling several miles northwestward from Big Bug, I entered the cañon to which I previously referred, and almost instantly found myself under the shade of Quercus Emoryi Torr., Alnus oblongifolia Torr., and Platanus racemosa Nutt. At either side, growing from the steep mountain slopes, were Juniperus Californica Carr. var. Utahensis Engelm., Juniperus pachyphlœa Torr., Pinus monophylla Torr. & Frem., and Canotia holacantha Torr. At my feet were many cones from Pinus ponderosa Dougl. which had been washed down by the stream from a dozen or more miles up the cañon.

Ascending the cañon, the banks of the stream on either side for rods are lined with the beautiful Aquilegia chrysantha Gray. Growing from the water were large bunches of Juncus tenuis Willd. and Scirpus pun-

gens Vahl., out of which were peeping the bright yellow flowers of Mimulus pilosus Watson. Here and there along the banks I gathered Nicotiana attenuata Torr., Nicotiana trigonophylla Dunal., Mimulus luteus L., Polygonum incarnatum Ell., Coreopsis cardaminaefolia Torr.& Gray, Asclepiodora decumbens Gray, Erythræa venusta Gray, Ambrosia psilostachya DC., Oxalis violacea L., Thalictrum Fendleri Engelm., Solidago Missouriensis Nutt., Solidago Canadensis L., Krameria parvifolia Benth., Aster ericæfolius Rothr., Viola Canadensis L., var. scopulorum, Œnothera albicaulis Nutt., Polygala hemipterocarpa Gray, Petalostemon multiflorus Nutt., Bœrhaavia spicata Choisy, Solanum nigrum L., Erigeron divergens Torr. & Gray, Helianthus petiolaris Nutt., Riddellia Cooperi Gray, Nama hispidum Gray, and Maurandia Wizlizeni Engelm.

Further up the cañon the stream is shut in by almost perpendicular walls of rock. In many places where the water slowly seeps through small fissures in these rocky walls, Mimulus cardinalis Dougl., one of the most beautiful of wild flowers, was growing in abundance. Here also were found Mirabilis multiflora Desf., and Heuchera parvifolia Nutt. In many places large areas of Pteris aquilina L. spread their broad fronds in the shade of the protecting rocks.

On my return to the station, my plant-can contained more than seventy-five species in fit condition for herbarium specimens.—J. W. TOUMEY, *Tuscon, Arizona.*

EDITORIAL.

BOTANICAL AUTHORITY seems to be following the same lines of evolution as political. It began with a system of tyranny or dictatorship that vested all such authority in a single individual. Linnæus seems to have ruled the botanical world with a rod of iron, and his word was law. There next followed the reign of a botanical aristocracy, whose spirit was not merely to snub but even to suppress the work of the less favored. Naturally, the spirit of freedom and independence gradually increased, and numerous became the revolts against self-constituted authority.

OUR OWN country has passed through the period of a botanical aristocracy, and there is a good deal of written and unwritten history concerning rank injustice done to both worthy but unknown botanists and known but underrated botanists. A new generation, however, has come to the front; one in which the spirit of democracy is prevalent,

one that proposes to fight not only its own battles but also those of all ancient neglected worthies.

THE THING TO OBSERVE is that we are slipping rapidly away from the time when a few persons or a few places represented the concentration of botanical authority, and are upon the threshold of a new order of things in which the voice of authority is to come from "the people." There may not be greater rivalry in feeling, but there will be far more successful rivalry; and the botanical landscape will represent a uniform forest rather than a cluster of sequoias towering in the midst of their lowly neighbors. Everything wrought out will have to run the gauntlet of the many instead of the few.

THIS CONDITION of things has been brought about by the wonderful spread of scientific training and the consequent development of independent thinking. In a general sense this is a far more desirable state of affairs, for it develops hundreds of efficient workers where there was only one before. It also has certain disadvantages common to all democracy. While it brings individual freedom it permits follies which a strong central power would have repressed. The new order of things, therefore, must be expected to be more of a "lo here" and "lo there" state of affairs, full of "fads" and erratic movements, and abounding more in worthless than worthy literature, but there is in it more of hope and promise for the rapid development of botanical science than under the former régime, for an aristocracy is always inclined to be ultra-conservative. It is only rebels who are apt to be extremists, and when there is nothing left to rebel against they usually settle down into staid and comfortable citizens.

OPEN LETTERS.

e pollination of Orchis spectabilis.

In the spring of 1891 while examining Orchis spectabilis, I was surprised to see the pollen masses, which I had withdrawn on the point of my pencil, turning backward, instead of downward, as one would expect from the position of the stigma below the anthers. When I pushed the pencil point into another flowers the pollen masses were quite out of position to fertilize the pistil. Yet this flower is said to set seed abundantly. Can any of the readers of the GAZETTE throw light upon the matter?—JANE H. NEWELL, *Cambridge, Mass.*

NOTES AND NEWS.

MR. W. W. CALKINS returned to Chicago from his collecting trip in Tennessee May 1.

A MONOGRAPH of the Myxoga stres covering 367 octavo pages and illustrated with twelve colored plates has recently been published by Mr. George Massee.

THE MARINE BIOLOGICAL LABORATORY at Wood's Holl opens its fifth season June 1. The botanical instruction will he in charge of Mr. W. A. Setchell of Yale University.

DR. F. ELFVING, of the University of Helsingfors, and Dr. M. Möbius, of the University of Heidelberg, have each been promoted from docent to a professorship in their respective institutions.

DR. J. C. ARTHUR sails for Europe June 4, for a two months' trip, principally in Germany. He goes largely to ascertain the possibilities and promote the interests of the Botanical Congress of 1893.

THE HERBARIUM of the University of Minnesota is growing so rapidly that the item published in the March number was out of date. That collection now contains upward of 60,000 plants, of which 25,000 are spermaphytes.

MM. L. MESCHINELLI AND S. SQUINABOL propose to publish, if sufficient encouragement thereto is offered, a work which is ready for press, on the Tertiary flora of Italy. 114 genera of cryptogams and 333 of phanerogams are known from this formation in Italy.

MR. WALTER H. EVANS is now in Arizona, in the employ of the Department of Agriculture, collecting living desert plants for the Columbian Exposition. It is the purpose of the Department to represent as completely as possible the characteristic vegetation of our southwestern arid regions.

AN APPRECIATIVE sketch of Sereno Watson appears in the *Bull. Torr. Bot. Club* (April) from the pen of Mr. Walter Deane. Mr. Deane is peculiarly qualified to write concerning Dr. Watson, as their intimate personal acquaintance brought the subject very often under the observation of the writer.

DR. THOS. C. PORTER has just described (*Bull. Torr. Bot. Club*, April) two new Eupatoriums, one from Tennessee, the other from New Jersey; four new varieties of as many species of Solidago; a new species of Solidago whose name, S. Roanensis, suggests its habitat; and a new Tripsacum from Florida.

THE DISAPPEARANCE of *Desmodium* from our flora, threatened by a botanist who curiously enough can sign himself "O. K.," is emphasized by Anna M. Vail in *Bulletin of Torrey Botanical Club* (April), who presents the synonymy of the genus *Meibomia*, as it occurs in the United States and British America.

THE PRINCIPAL ARTICLE in the last number of *Flora* (1892, Heft 2) is on the photometric movements of plants by F. Oltmanns. Shorter articles are by J. Sachs, physiological notes, A. Doyel on the morphology and development of the starch grains of Pellionia, and F. Noll on the culture of marine algæ in aquaria.

FLORA FRANCISCANA, Part III, presents the following orders and sequence: Papaveraceæ, Nymphæeæ, Sarraceneæ, Drosereae, Laurineae, Berberideae, Ranunculaceae, Sarmentosae (Vitaceae), Araliaceae, Umbelliferae, Corneae, Elaeagneae, Daphnoideae (Thymelaeaceae), Santalaceae, Lorantheae, Caprifoliaceae, Rubiaceae, Valerianeae.

THE USUAL summer courses in botany at Harvard University are announced. Mr. W. F. Ganong and Mr. G. J. Pierce will conduct two courses each in morphology and physiology and in histology, while Mr. A. B. Seymour offers (for advanced students only) two courses, one in general cryptogamic botany and one in economic mycology.

MESSRS. J. K. SMALL and Luther D. Reed will make a botanical expedition during the coming season from the southwestern corner of Virginia to the Mississippi river along the southern border of Kentucky. The region is a rich collecting field but little explored. Those desiring to arrange for the purchase of sets of specimens can address Mr. Reed at Lancaster, Pa.

MR. JOHN S. WRIGHT has accepted the position of botanist in the pharmaceutical establishment of Eli Lilly & Sons, Indianapolis, Ind., as successor to Walter H. Evans, who resigned to take a position in the botanical division of the U. S. Department of Agriculture. Mr. Wright enters upon his duties in June at the completion of his undergraduate studies in Purdue University.

THE SECRETARY of the Society for the Promotion of Agricultural Science has decided to postpone the publication of the proceedings of the society for 1891 until after the next meeting, which occurs in August. The unfortunate delay is necessitated by the failure of the printing firm having the contract to resume work since their establishment was destroyed by fire in January last.

IN THE SUMMER SCHOOL of the University of Wisconsin, courses in botany planned with special reference to high school teachers are offered. One is a "model course," embracing instruction in the method and on the topics which Prof. Barnes thinks desirable and practicable in high schools having limited equipment. Advanced work in anatomy is also offered.

SOME IDEA of the growing attractiveness of the Royal Gardens at Kew may be obtained from the report of the number of visitors in each decennial year, a record which now covers 50 years. In 1841 there were 9,174 visitors; in 1851, 327,900; in 1861, 480,070; in 1871, 577,084; in 1881, 836,676; in 1891, 1,373,753. On a single holiday, (May 26, 1890), the attendance was 106,808.

DR. J. H. SANDBERG, Messrs. D. T. MacDougal and A. A. Heller have gone to Idaho under the auspices of the Botanical Division of the Department of Agriculture to make an extended botanical exploration along the Clear Water river, the Nez Perces Reservation, thence northward to the Bitter Root mountains, and down into the Clark Fork of the Columbia river. Their headquarters are at Lewiston, Idaho.

THE EXPEDITION TO WESTERN AFRICA under the direction of Mr. O. F. Cook, of Syracuse University, has been unfortunate and has accomplished much less than anticipated on account of tropical fever.

Every member of the company has been ill, necessitating a complete change in the original plans. Mr. Cook expects to again attempt to penetrate the interior of Moravia, and then return to America the coming August. The other members of the expedition will probably return sooner.

THE CONSTITUTION and list of members of the Ohio Academy of Sciences have been issued as a twelve-page pamphlet. The Academy was organized Dec. 31, 1891, with fifty-four charter members. The Nebraska Academy of Sciences was organized Jan. 1, 1891, with forty charter members. It has published the constitution and list of members in an eight-page pamphlet, and more recently a twenty-four page pamphlet containing abstracts of papers read at the second annual meeting Dec. 31, 1891, largely botanical.

THE ITALIAN BOTANICAL SOCIETY on behalf of the city of Genoa, Italy, invites the botanists of every nationality to a Botanical International Congress to be held Sept. 4 to 11, 1892, in commemoration of the fourth centennial of the discoveries of Columbus, a citizen of Genoa. It will also be the occasion of the opening of a new Botanical Institute and of a horticultural exhibition. Excursions and other festivities are offered by the municipality of Genoa and also by the Botanical Society. It is hoped to make the gathering truly cosmopolitan.

THE JOURNAL OF MYCOLOGY, issued by the Division of Vegetable Pathology of the U. S. Department of Agriculture, is constantly increasing in size and interest. The last number contains seventy pages of original matter on plant diseases and new species of fungi, illustrated with seven plates and several text cuts. Seven publications are reviewed at considerable length, and the number closes with forty-two pages of index to current literature. This index is a most commendable and useful feature and especially as at present conducted. The citations are followed in each case by a brief résumé of contents of the work. The Chief of the Division thoughtfully offers to supply extra copies of the index to those who wish to arrange the numbers in a card catalogue.

AN UNUSUAL NUMBER of Experiment Station bulletins containing botanical matter have been issued in the last month. The Arizona Station proposes (No. 5) to make a study of the native Rumex hymenosepalus, locally known as cañaigre, as a tannin-producing plant. F. H. Hillman (Nev., No. 15) describes and illustrates Cuscuta epithymum, C. arvensis, and C. denticulata as pests of alfalfa (Medicago sativa). Fungous diseases of plants and their treatment are discussed by W. C. Sturgis (Conn., No. 111), L. H. Pammel (Iowa, No. 16), S. A. Beach (N. Y., No. 40), S. T. Maynard (Hatch, No. 17), J. C. Arthur (Ind., No. 39) and C. F. Millspaugh (W. Va., No. 21). Geo. F. Atkinson (Ala., No. 36) gives an interesting and extended account of his study of yellow leaf blight of cotton, a physiological disease. The annual reports of New Jersey (1890), Connecticut (1891) and Indiana (1891) Stations also contain matter on plant diseases by B. D. Halsted, R. Thaxter and J. C. Arthur respectively. Nearly all of these articles are well illustrated.

BOTANICAL GAZETTE

JUNE, 1892.

On nomenclature.

SERENO WATSON.

[It was the request of the late Dr Sereno Watson that the following communication, dictated by him in his last illness, should appear at an early date in the BOTANICAL GAZETTE.—EDS.]

For some time I have had a desire to give expression to my views upon botanical nomenclature. Under the circumstances, I must speak briefly and somewhat dogmatically. In my opinion botany is the science of plants and not the science of names. Nomenclature is only one of those tools which is necessary to botany, and this being the case, points of nomenclature should be subordinated to science.

A principle of botanical convenience has been established by those who prefer one name to another on account of expediency or convenience. This principle should have a great deal of influence. It has been so recognized by the greatest botanists, and from their authority receives great weight. I prefer the word *expediency* as a better term than convenience to designate the principle, that the demands of science override any merely technical claims of priority, etc.

Priority of specific names appears to be based entirely upon one section of the Code of 1867. That simply says that when a species is transferred from one genus to another, the specific name is maintained. This principle is usually understood and applied in the way that the oldest specific name has a right in all cases to be retained. It cannot fairly be so interpreted and applied, since it governs only to the extent that this should be the law, but it is not to be made an *ex post facto* law. Thus when a transfer has been made, that ends the matter so far as the choice of a specific name is concerned, and no one is authorized to take up a different name. This practice of retaining the oldest name *under the genus*, no matter what older specific names there may be, was adopted by Dr. Gray in his later years and by the Kew bot-

anists, for the reason that once established and pretty generally recognized, it would avoid the great mass of synonymy, which is being heaped like an incubus upon the science. I must express surprise that Dr. Britton has not considered it his duty to publish the last written words of Dr. Gray which were addressed to him upon this subject and which expressed his positive opinions upon this point.

There is nothing whatever of an ethical character inherent in a name through any priority of publication or position which should render it morally obligatory upon anyone to accept one name rather than another; otherwise it would be applicable or true as well in the case of ordinal names, morphological names, teratological, and every other form of name, to which now no one feels himself bound to apply the law of priority. The application of this law as at present practiced by many botanists, which would make it the one great law of botanical nomenclature, before which every other must yield regardless even of common sense, is a mere form of fetichism exemplified in science. Many instances of the application of this law are not science but are rather superstition.

February 22, 1892.

The North American Lejeuneæ.

F. STEPHANI.

In his Descriptive Catalogue of N. A. Hepaticæ Dr. Underwood has collected the names of all Lejeuneæ reported to have been found in the United States and Canada. Amongst these are four species, which Taylor published as having come from Cincinnati, while they had been collected on the shores of the Amazon, near the city of Pará, which Taylor believed to be a place in the vicinity of Cincinnati. These four species are *Lej. cyclostipa*, *polyphylla*, *testudinea* and *longiflora*, all of which having been described before, now bear other names. His *Lejeunea calyculata* too is merely the common form of *Lej. clypeata* Schweinitz. There remain only the following species, to which I have added four newly detected plants: *Lej. trifaria* Nees, *Lej. Wrightii* G., *Lej. Cardoti* Steph., *Lej. Underwoodii* Steph. The North American Lejeuneæ have to be arranged as follows:

a. Holostipæ.

1. *Neuro-Lejeunea catenulata* Nees: a most beautiful little plant and well described, page 323, in Synopsis Hepaticarum.

2. *Archi-Lejeunea clypeata* Schweinitz.
Syn.: *Lej calyculata* Taylor.

3. *Archi-Lejeunea xanthocarpa* L. & L.: quite different from *Lej. catenulata* to which it has not the least resemblance.

4. *Mastigo-Lejeunea auriculata* Hook. & Wils.
Syn : *Phragmicoma versicolor* L & L

5. *Lejeunea Mohrii* Austin, which I have not seen.

b. Schizostipæ.

6. *Euosmo-Lejeunea trifaria* Nees: newly detected in Florida, in large tufts on bark of trees.

7. *Eu-Lejeunea Austini* Lindb.

8. *Eu-Lejeunea Caroliniana* Aust.

9. *Eu-Lejeunea serpyllifolia* Libert.

10. *Eu-Lejeunea Underwoodii* Steph. n. sp.

11. *Micro-Lejeunea Cardoti* Steph. n. sp.

12. *Micro-Lejeunea lucens* Taylor: not at all identical with *Lej. cucullata* Nees, which looks more like *Lej. minutissima.*

13. *Micro-Lejeunea ulicina* Taylor: Lindberg found this in a tuft of *Lej. serpyllifolia* from Charleston; see his Hepaticæ in Hibernia lectæ, page 482. Taylor gave this name to a minute plant with stipules, while *Lej. minutissima* Smith has none; the synonymy has been much confused and even Lindberg has fallen into errors, which Spruce has already corrected. I wish to repeat, therefore, that Lindberg's *Lej. inconspicua* is the true *Lej. minutissima* while his *Lej. minutissima* is *Lej. ulicina.*

14. *Colo-Lejeunea calcarea* Libert (1820): a name for which Lindberg has substituted Taylor's name *Lej. echinata,* which was not given before 1844. Hooker published this plant as *Jungermania hamatifolia,* var. *echinata;* Mme. Libert, recognizing it as a distinct species was not obliged to use the name echinata. Lindberg in doing so, wronged the old author and multiplied the names without any necessity. Spruce in his admirable work on the Hepaticæ Amazonicæ et Andinæ, page 292, uses the name *Lej. calcarea* Libert.

15. *Colo-Lejeunea Jooriana* Aust. I have not seen.

16. *Colo-Lejeunea minutissima* (Smith.)
Syn.: *Lejeunea inconspicua* De Notaris.

17. *Colo-Lejeunea parvula* Aust. I have not seen. See Lindberg l. c. page 481.

18. *Colo-Lejeunea Wrightii* Gottsche: this plant, growing on bark of living trees, has been sent me from Louisiana, leg. Langlois. It was known before from Cuba, and together with *Lej. trifaria*, *L. auriculata* and *L. xanthocarpa*, is largely distributed throughout tropical America. The last species is found also throughout Africa, where it has been found on the slopes of the Kilimandscharo, in the island of Fernando Po opposite Cameroon and also at the Cape of Good Hope. Truly an extensive distribution!

There remain two species, which I have never seen and the suborder of which is not to be recognized from the descriptions; these are .

19. *Lejeunea laete-fusca* Austin.

20. *Lejeunea Ravenelii* Austin.

I conclude by giving the descriptions of the before named new species viz.:

Micro-Lejeunea Cardoti n. sp.—Dioica, exigua, dense caespitosa, viridis. *Caulis* multiramosus, ramis recte patentibus, filiformibus. *Folia* normaliter late ovata, oblique patentia, dorso longe soluta, ventre grandilobulata, *lobulus* inflatus apice excisus, hamatim longe dentatus. Folii *cellulae* I . Incrassatis angulosa nulla. Ocella 3 ad basin folii 0.017×0.025 mm. Plurima folia lobulos reductos, plicaeformes, ostendunt. *Amphigastria* ovata, usque ad basin fere bifida, laciniis lanceolatis. Flores feminei pseudolaterales; *folia floralia* subaequaliter biloba, conduplicato-concava, lobis brevibus obtusis. *Amphigastrium florale* foliis suis aequilongum, ovatum, ad $\frac{1}{8}$ bifidum, lobis obtusis. *Perianthium* pyriforme, *inflato-quinquangulare*, rostro subnullo.

Proxima *Lejeuneae ulicinae*, quae differt foliis fere rotundis, dorso longius accretis, foliorum lobulo multo majore, dimidium folii tegente, cellulis distincte incrassatis. *Lejeunea bullata* Taylor differt foliis fere erectis, ellipticis. *Lejeunea lucens* T. multo major est et toto coelo diversa.

HAB.: Louisiana (*Langlois*). Mexico (*Pringle*).

Eu-Lejeunea Underwoodii n. sp.—Dioica, flavicans, dense depresso caespitosa, minor. *Caulis* vage ramosus, flaccidus. *Folia* subplana, late ovata, oblique a caule patentia, antice caulem tegentia haud superantia, apice *angulato-repanda*. *Cellulae* foliorum margine 0.012 mm., medianae 0.017 mm.,

basales 0.017×0.025 mm., *trigonis magnis acutis*. *Lobulus* diametro caulis duplo longior, decurrens, carina arcuata sinu lunato in folium excurrente, apice exciso-truncatus, angulo brevidentato, ceterum valde convexus, margine supero involuto. *Amphigastria* caulina ovata, caule plus duplo latiora, ad medium fere bifida, sinu angusto laciniis acutis. *Flores feminei* in caule ramisque pseudolaterales, raro in angulo furcarum. *Folia floralia* caulinis minora, arcuatim divergentia, e basi angusta falcato-oblonga, lobulo lanceolato profunde soluto, acuto. *Amphigastrium florale* foliis suis aequimagnum, oblongum, ad ⅓ incisum, rima angusta, laciniis muticis.

Perianthia et *androecia* ignota.

HAB.: Florida (*Underwood*). *Lejeunea Caroliniana* monoica est. *Lejeunea Austini* cellulis multo minoribus gaudet. A remarkable feature in this plant is the *large incrassations* at the angles of the cells, which form very distinct triangles with acuminate points.

Kaiser Wilhelm str. 9., Leipzig, Germany.

Flowers and insects. VIII.

CHARLES ROBERTSON.

ISOPYRUM BITERNATUM Torr. & Gray.—The plants grow in damp, rich woods, in small patches, notably about bases of trees. The stem rises a few inches and bears a few-flowered cyme, in which only one or two flowers are open at the same time.

The flowers are white, sometimes with a purplish tinge; they are strongly heliotropic and measure about 14 or 15 mm. across, the five oval petals expanding horizontally. The stamens are numerous, the outer elongating and discharging pollen first. Nectar is probably secreted by the bases of the filaments; insects probe among them with their proboscides, evidently for nectar. The four styles at first overtop the inner stamens, and have receptive stigmas before any of the anthers discharge, so that the flower is female in the first stage.

When the cyme contains two open flowers, one of them is commonly in the male, the other in the female stage. In case of insect visits, the latter is more apt to receive pollen from another stem, but may receive it from the older flower

on the same stem. If the stigmas are not pollinated before the outer anthers begin to dehisce, they might receive pollen from them by insect aid or by the closing of the petals. Later, when the inner anthers discharge, if the stigmas remain unfertilized, they may receive pollen falling from the anthers which now overtop them. But insects are by far the most important agents in effecting self-pollination, which, however, I think is the exception.

The flowers remain open all day and open on two or three successive days. For the attention of insects the plant is in strong competition with a number of plants, most of which have the advantage, especially *Claytonia Virginica*, which is much more abundant and more attractive.

The flower is adapted to short-tongued bees and flies, which come for both honey and pollen. It seems especially attractive to bees of the genus *Halictus;* the list shows all of the early-flying species I have found in my neighborhood, except *H. ligatus* and *confusus*, and more species than I have ever found on any other flower.

I have found the flowers in bloom from March 24 to May 12. On twelve days, between March 26 and April 25, I observed the following visitors:

Hymenoptera—*Apidae:* (1) Apis mellifica L. ☿, s. & c. p., freq.; (2) Bombus americanorum F. ♀, s., one; (3) Synhalonia honesta Cr. ♂, s., one; (4) Ceratina tejonensis Cr. ♂, s.; (5) C. dupla Say ♂, s.; (6) Osmia albiventris Cr. ♂ ♀, s.; (7) Nomada bisignata Say ♂ ♀, s.; *Andrenidae:* (8) Andrena bicolor F. ♂ ♀, s., freq.; (9) A sayi Rob. ♂ ♀, s.; (10) A. erigeniae Rob. ♂ ♀, s.; (11) A. flavo-clypeata Sm. ♀, c. p.; (12) A. rugosa Rob. ♂ ♀, s.; (13) A. forbesii Rob. ♀, s.; (14) A. claytoniae Rob. ♂, s.; (15) Agapostemon radiatus Say ♀, s.; (16) Augochlora labrosa Say ♀, s.; (17) A. pura Say ♀, s.; (18) Halictus gracilis Rob. ♀, s.; (19) H. 4-maculatus Rob. ♀, s.; (20) H. pectoralis Sm. ♀, s.; (21) H. coriaceus Sm. ♀, s.; (22) H. forbesii Rob. ♀, s.; (23) H. lerouxii Lep. ♀, s. & c. p.; (24) H. fasciatus Nyl. ♀, s. & c. p., ab.; (25) H. cressonii Rob. ♀, s.; (26) H. pilosus Sm. ♀, s.; (27) H. obscurus Rob. ♀, s. & c. p., ab.; (28) H. stultus Cr. ♀, s., c. p., f. p.; (29) H. zephyrus Sm. ♀, s., ab.; (30) H. imitatus Sm. ♀, s., one; (31) Colletes inaequalis Say ♂, s.

Diptera—*Bombylidae:* (32) Bombylius fratellus Wd., s., ab.; *Empidae:* (33) Empis sp., s., one; *Syrphidae:* (34) Chil-

osia capillata Lw.; (35) Melanostoma obscurum Say; (36) Syrphus ribesii L.; (37) S. americanus Wd.; (38) Mesograpta marginata Say; (39) M. geminata Say; (40) Sphaerophoria cylindrica Say; (41) Eristalis dimidiatus Wd.; (42) Helophilus similis Mcq.; (43) Xylota fraudulosa Lw.—all s. & f. p.; *Tachinidae:* (44) Gonia frontosa Say, s.; *Muscidae:* (45) Lucilia cornicina F., s.

Coleoptera—*Coccinellidae:* (46) Megilla maculata DeG., f. p., one; *Chrysomelidae:* (47) Diabrotica vittata F., f. p., one; *Œdemeridae:* (48) Asclera ruficollis Say, f. p.; *Anthicidae:* (49) Corphyra terminalis Say, f. p.

Hemiptera—*Capsidae:* (50) Lygus pratensis L., s., one.

SANGUINARIA CANADENSIS L.—This is a common plant of wide distribution. In my neighborhood, however, it is rather rare; at any rate, I know of but a few stations for it.

Each plant bears a single scape rising about one decimeter and supporting an 8 to 12-petaled, white flower, which expands about 4 or 5 cm. The plants are sometimes collected in little clusters, so that the flowers are made quite conspicuous and must attract insects from a distance. In the morning the petals are expanded horizontally, but in the afternoon they become more erect, preparatory to closing.

The flowers are female in the first stage. On the first day of opening, the large, two-lobed stigma is receptive, while the anthers are still closed. By the time the anthers are beginning to discharge, the stigma has turned brown, its papillae appearing shriveled.

The numerous stamens are of unequal length, the outer being much shorter. The tips of the inner anthers sometimes barely rise as high as the stigma, in which case, provided pollination has not previously occurred, the stigma might receive a little pollen from the surrounding anthers. The pollen is the attraction for insects, although I have seen hive-bees and *Bombylius fratellus* Wd. vainly probing for nectar about the base of the ovary.

The newly opened flowers are smaller and less widely expanded. Insects land upon them, dusting their stigmas before perceiving that the anthers are indehiscent. The result is cross-fertilization between distinct plants.

In competition with *Sanguinaria* are *Anemonella thalic-*

troides, Isopyrum biternatum, Claytonia Virginica, Erigenia bulbosa and *Erythronium albidum*, all of which have the advantage.

The flowers are monopolized by hive-bees, which collect the pollen so effectually that it is very difficult to find out what were the normal visitors of the flower. There is little doubt, however, that the plant originally depended for fertilization mainly upon the aid of bees of the genera *Halictus* and *Andrena* and flies of the family *Syrphidae.*

I have found the flowers in bloom from April 2 to 13. On April 13 I noted the following visitors:

Hymenoptera—*Apidae:* (1) Apis mellifica, L. ☿, c. p., ab.; *Andrenidae:* (2) Halictus zephyrus Sm. ♀, c. p.; (3) H. stultus Cr. ♀, c. p.

Diptera—*Syrphidae:* (4) Syrphus sp., f. p.

Coleoptera—*Œdemeridae:* (5) Asclera ruficollis Say, f. p., freq.

I also saw several individuals of *Andrena bicolor* F. ♂ flying about the flowers in search of the female, which is probably a visitor.

At Madison, Wisconsin, May 9, Professor Trelease found the flower visited for pollen by *Andrena bicolor* F. ♀ and *Halictus confusus* Sm. ♀.

BAPTISIA LEUCOPHAEA Nutt.—This plant is rare in my neighborhood; I know of but one station for it, on creek bluffs. The stems rise about a foot from the ground, are diffusely branched and bear large, drooping racemes of handsome, cream-colored flowers.

The calyx tube measures about 5 or 6 mm. and serves to hold the petals so that they can not easily be separated by intruders. The banner runs forward for about 14 mm. when it rises nearly straight upwards. Its blade measures 20 mm. or more in breadth, and is not so strongly reflexed at the sides as in *B. leucantha.* The wings extend forward and conceal the keel. At the base above, the blade is inflected upon a gibbosity upon the base of the keel, with the result that, when a bee lands upon the flower, it depresses both wings and keel.

The stamens are distinct. Since there is is no special opening at the base to admit the bee's tongue, as in the diadel-

phous Papilionaceae, the bee inserts its proboscis between the upper filaments. The filaments are somewhat unequal in length. The anthers dehisce in succession, so that to remove all of the pollen, bees must visit each flower several times. The stigma is situated among the anthers, and I find nothing to prevent self-pollination. The flower has more accessible nectar than in B. leucantha, but on account of its early blooming, it has less need of adaptation to exclude shorter tongues, since it is mostly exposed to *Bombus* females and species of *Synhalonia*.

Osmia latitarsis was the only bee visiting it for both honey and pollen, and there may be an important relation between the flower and the bee, which are both equally rare. I have as yet taken the female of this *Osmia* only on the present flower.

The following list of visitors was observed on May 16 and 19:

Apidae: (1) Bombus separatus Cr. ♀, s.; (2) B. americanorum F. ♀, s.; (3) Synhalonia speciosa Cr. ♀, s.; (4) Osmia latitarsis Cr. ♀, s. & c. p.

TRIFOLIUM PRATENSE L.—("Adv. from Eu.")—I have been much interested in observing how frequently this well-known bumble-bee flower is visited by Lepidoptera. It is a common thing for bee-flowers to be visited to some extent by butter-flies, but this seems to me to be an unusual case. In Germany, Müller found it visited by 8 Lepidoptera in a list of 39 insects, while in Illinois I have found it visited by 13 species in a list of 20. Our flowers are exposed to a richer butterfly-fauna, so that we may expect to find a larger proportion of butterflies upon them, and the differences between bee and butterfly-flowers may not be so well indicated in the lists of visitors.

But while butterflies may sometimes effect cross-fertilization of the red clover, they are of doubtful value, if not injurious. Bumble-bees depress the keel so that their heads and proboscides are well dusted with pollen. But butterflies can insert their thin tongues without depressing the keel, and, even if they get a little pollen on their thin proboscides, it is apt to be wiped off by the closely approximated tips of the petals, which close the mouth of the flower.

I have found it in bloom from April 26 to Nov. 4. On 15 days, May 10 to Sept. 11, I noted as visitors:

Hymenoptera—*Apidae:* (1) Bombus ridingsii Cr. ♂, once; (2) B. separatus Cr. ♂ ♀ ☿, ab.; (3) B. pennsylvanicus DeG. ♀ ☿, ab.; (4) B. americanorum F. ♂ ♀ ☿, very ab.; (5) B. vagans Sm. ☿, s., one; (6) Anthophora abrupta Say ♂ ♀.

Lepidoptera—*Rhopalocera:* (7) Danais archippus F.; (8) Argynnis cybele F.; (9) Pyrameis atalanta L.; (10) P. huntera F.; (11) P. cardui L.; (12) Lycaena comyntas Godt.; (13) Papilio cresphontes Cram.; (14) Pieris rapae L.; (15) Callidryas eubule L.; (16) Pamphila peckius Kby.; (17) P. cernes B.-L.; (18) Eudamus tityrus F.; *Sphingidae:* (19) Hemaris axillaris G.-R.

Birds—*Trochilidae:* (20) Trochilus colubris L., thrice.

The following table gives the visitors which have been observed sucking the flowers in the normal way:

REGION.	Bombus.	Anthophora.	Eucera.	Anthidium.	Megachile.	Osmia.	Bombylius.	Lepidoptera	Trochilus.	Total.
1. In Low Germany—Müller,[1]...	12	1	1	1	1	1	8	..	..	25
2. In the Pyrenees—MacLeod,[2]..	6	1	..	..	..	..	1	11	..	19
3. In Illinois....................	5	1	..	..	..	..	..	13	1	20

HEUCHERA HISPIDA Ph.—Each plant of this common species bears several scapes, which rise 6 to 9 dm., and bear long panicles of greenish flowers.

The calyx is oblique, being quite gibbous on the lower side. It measures about 6 mm. in length, the lobes being directed forward and a little inward and the petals filling the intervals, so that the effect is much the same as if the parts were united to their tips. The tube is very broad, measuring about 4 mm. wide, so that it readily admits the head and thorax of a bee.

The stamens lengthen and discharge pollen in succession, beginning with the upper one. Accordingly, to collect all of the pollen, the flower must be visited several times.

The flowers are proterogynous[3] with long-lived stigmas, and are remarkable for being visited exclusively by a species

[1] Fertilization of Flowers. [2] Pyreneënbloemen. [3] Müller, Fertilization of Flowers, 243.

of *Colletes*, *C. heucherae* Rob., the females coming for honey and pollen, and the males for honey and in search of the females.

It blooms from May 11 to June 29.

LYTHRUM ALATUM Ph.—The plants are common in wet places. The stems grow 4 or 5 dm. high, are much branched and bear many loose racemes of purple flowers. The six petals are each marked with a reddish line leading to the base. They expand so that the flowers measure 15 mm. across.

The dimorphism of the flowers was first recorded by Halsted in the Bulletin of the Iowa Agricultural College, 1888. In the short-styled form the stigma reaches the throat of the calyx tube, and the stamens are exserted from 3 to 4 mm. In the long-styled form the stigma is exserted about 3 mm., and the anthers only reach the throat. In this form the stamens are variable, sometimes giving an appearance of trimorphism; but the unequal length seems only to prevent crowding of the anthers in the narrow tube.

The plants often grow in large patches, which renders them quite conspicuous, and very attractive to insects. The calyx-tube is narrow and measures 5 or 6 mm. in length, which restricts the visitors to long tongues. The principal visitors are butterflies. On 12 days, June 18—Aug. 18, the following list was observed:

Hymenoptera—*Apidae:* (1) Bombus virginicus Oliv. ☿, s. & c. p., freq.; (2) Melissodes bimaculata Lep. ♂, s., freq.; (3) Megachile petulans Cr. ♂, s.; (4) M. brevis Say, ♂ ♀, s., freq.; (5) Coelioxys 8-dentata Say ♀, s.; (6) Epeolus lunatus Say ♀, s.; *Andrenidae:* (7) Agapostemon nigricornis F. ♀, s.

Lepidoptera—*Rhopalocera:* (8) Pieris protodice B.-L.; (9) P. rapae L.; (10) Colias philodice Godt.; (11) Pyrameis cardui L.; (12) Chrysophanus thoe B.-L; (13) Pamphila peckius Kby.; (14) P. cernes B.-L.; (15) Pholisora catullus F.—all s.

Diptera—*Bombylidae:* (16) Systoechus vulgaris Lw.; (17) Exoprosopa fasciata Mcq.; (18) E. fascipennis Say—all s.; *Syrphidae:* (19) Helophilus latifrons Lw.; (20) Tropidia quadrata Say—both f. p.

Carlinville, Ill.

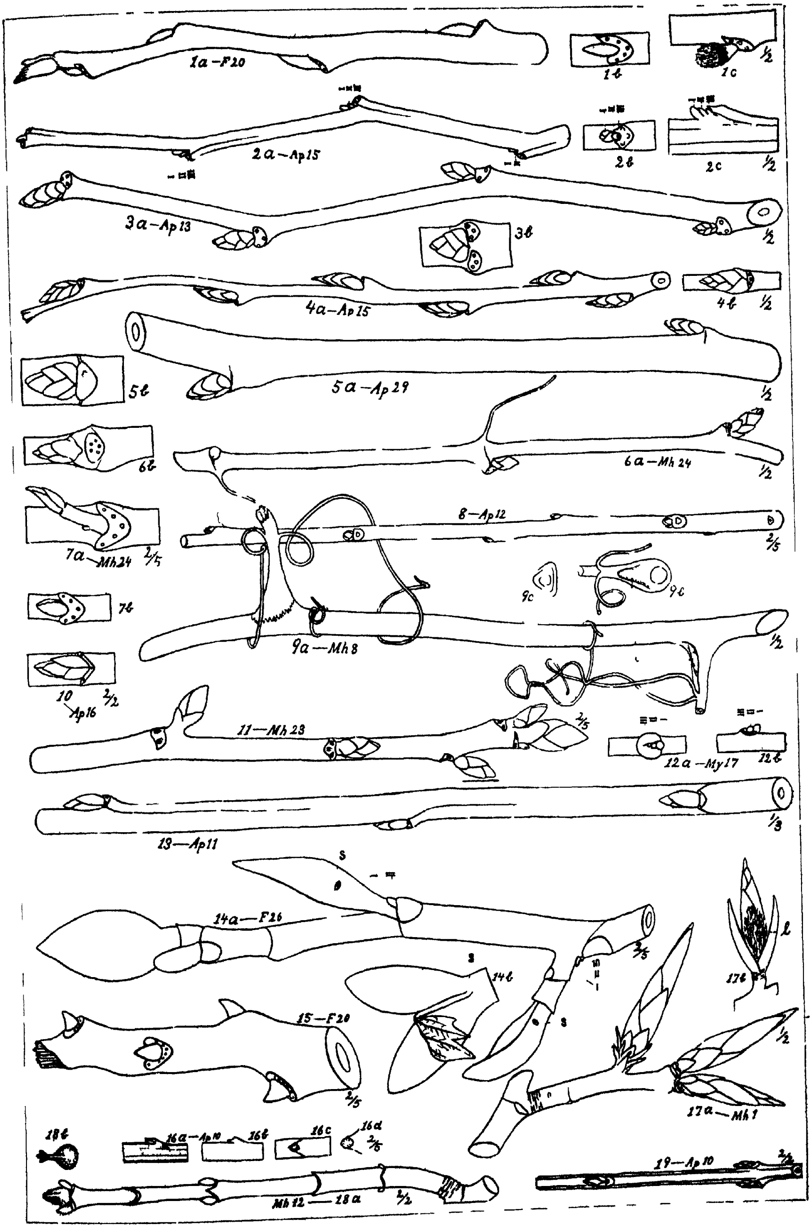
The identification of trees in winter.

AUG. F. FOERSTE.

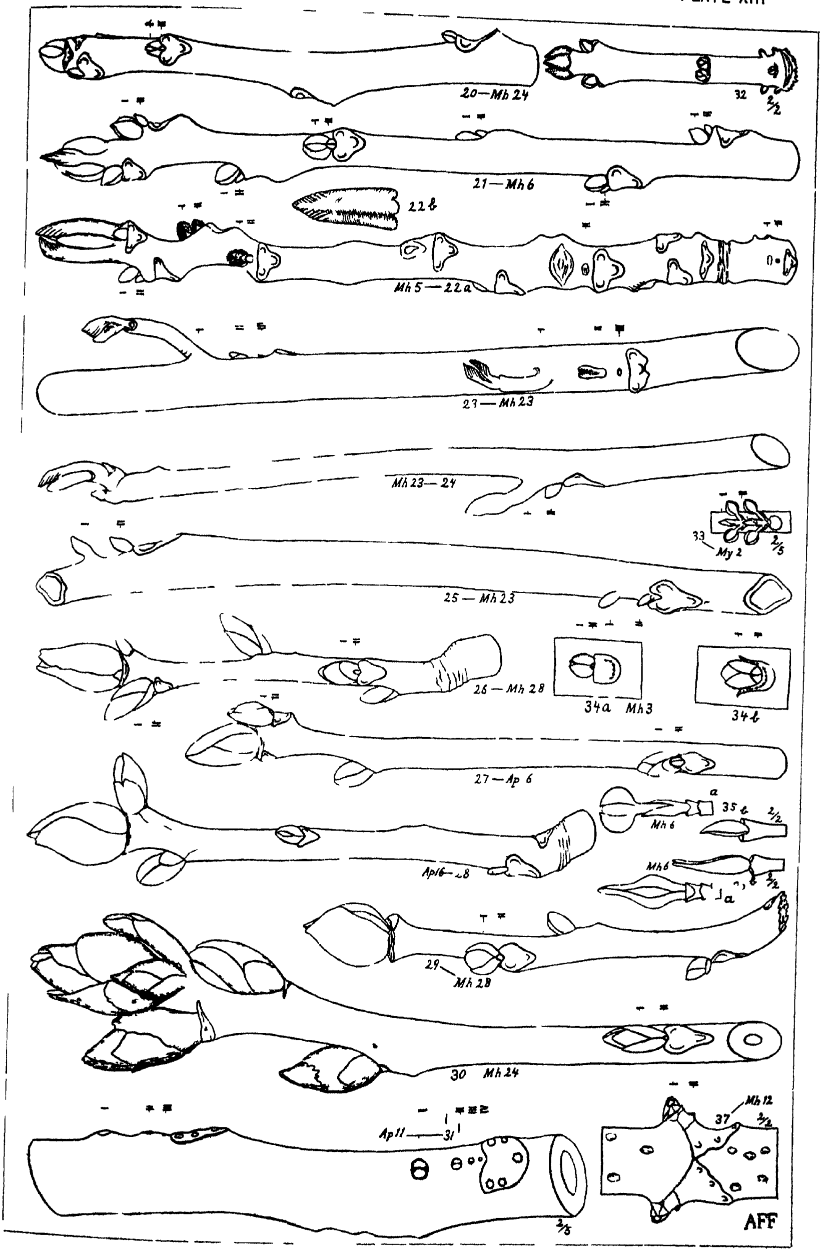
(WITH PLATES XII AND XIII.)

Any method of identifying ligneous plants other than the ordinary one by means of their flowers and leaves, must necessarily be very artificial. Under these circumstances it is important to use as a means of comparison those parts of ligneous plants which are certain to be present both in the young growth and in the fully matured plant, and which, during the various stages of development from the small sapling to the superannuated tree, show essentially the same characteristics. There is only one part of ligneous plants which approximately fulfills these conditions and that is the crop of little twigs added each year to the tips or the sides of the branches, with the petiole-scars from the last season's leaves and the subtended, more or less scaly, winter buds which enclose a portion or all of the growth of the coming season in rudimentary form.

As a matter of fact the length of these twigs varies considerably at different stages in the history of the same individual and even on different branches of the same tree or shrub during the same season; moreover the form and size of the petiole-scars and the scaly buds vary quite commonly on approaching the tips or the base of even the same twig. If, however, the length of a twig be left out of consideration, and only the larger petiole scars and scaly buds be made objects of comparison, the constancy of color and markings of the bark, of the character of the pith, of the form and structure of the petiole-scars, of the figures presented by the foliar fibrovascular bundles, and of the form and structure of the scaly buds, is very striking. This constancy of characteristics within the limits of the same species is supplemented by sufficient *variation* in the features presented by *different* species, to make it possible to use these characteristics in recognizing the genus of ligneous plants and, in the great majority of cases, also the species. The various characteristics presented by ligneous plants will be discussed in the order of the importance, thus providing at the same time a plan in accordance with which ligneous plants can be classified artificially so as to facilitate their identification.



FOERSTE on TREES in WINTER



FOERSTE on TREES in WINTER

I. The determination of the phyllotaxy of the leaves of the species examined, as shown by the petiole-scars remaining from last year's leaves, is the first step towards identification. It so happens that a classification of shrubs and trees into those with alternate, spiral, and opposite or whorled leaves gives rise to three fairly equal sets. The determination of the phyllotaxy of a plant at once excludes quite a large list of shrubs and trees with another kind of arrangement of leaves from the list of possibilities. The rarer phyllotaxies such as $\frac{1}{3}$ (*Spiræa opulifolia* Linn., fig. 13); $\frac{3}{8}$ (*Diospyros Virginiana* Linn.) and $\frac{2}{3}$ (*Catalpa speciosa* Warder) will of course make the identification of a ligneous plant still more easy. In certain species the phyllotaxy is occasionally or even quite regularly (*Castanea*) more or less variable in different twigs of the same tree, but these cases are sufficiently rare not to give any serious difficulty.

II. The form of the more fully developed petiole-scars and the mode of disposition of the fibrovascular bundles where intersected at the petiole-scar is the second important means of classifying ligneous plants. The following are some of the most important types:

1. In those petiole-scars where the outline is markedly rounded, the fibrovascular bundles are often arranged in a sort of circle within the scar (*Morus rubra* Linn., fig. 5; *Ampelopsis quinquefolia* Michx., fig. 6; *Celastrus scandens* Linn., fig. 8; *Rhus aromatica* Ait., fig. 16; and *Catalpa speciosa* Warder). Sometimes these bundles take the form rather of a circular area than of a circle.

2. In those petiole-scars which have a broadly circular form below but a square outline above, the fibrovascular bundles are often arranged in the form of a semicircle (*Euonymus atropurpureus* Jacq., fig. 19; species of *Fraxinus*).

3. In certain petiole-scars which are strongly horseshoe shaped the bundles form a series having approximately the same shape (*Ptelea trifoliata* Linn., *Rhus glabra* Linn., fig. 15; as variations of the last type, in species of *Fraxinus*). In the preceding three types the fibrovascular bundles are arranged in an approximately continuous series. In many other cases they form several distinct sets in the same scar.

4. Thus in certain scars, usually more or less heart shaped, these bundles form lunate sets, either in considerable number

(*Ailanthus glandulosus* Desf.) or only with three in each scar (species of *Juglans*, *Pterocarya*, *Carya*, figs. 20-30.

5. In other scars of heart-shaped form, and in the great majority of those which are lunate, the fibrovascular bundles form small circular areas. These show a sufficient constancy in their number within the same scar if only the more fully developed scars be examined and if quite a number of twigs be drawn into consideration, so that a division into scars with only three sets (*Ulmus fulva*, Michx., fig. 3; *Celtis occidentalis* Linn., fig. 4; *Viburnum molle*, fig. 10; *Nyssa multiflora* Wang., fig. 11; *Spiraea opulifolia* Linn., fig. 13; *Hamamelis Virginica* Linn.), and into scars having five rounded sets of fibrovascular bundles is possible (*Asimina triloba* Dunal., fig. 1; *Rhus Toxicodendron* Linn., fig. 7; species of *Æsculus*). Sometimes these sets, normally five, are reduced to three in all the smaller scars, or on the weaker twigs. In other species the number usually five is occasionally raised to seven (*Sambucus Canadensis* Linn., fig. 37). The two outer sets are often more or less approximated while the median fifth set is left more isolated (*Gymnocladus Canadensis* Lam., fig. 31; *Acer saccharinum* Wang.). How far this character remains constant and therefore of value for present purposes has not been determined.

In species with opposite leaves it is also frequently of assistance to notice if the edges of the petiole scars are sufficiently extended laterally almost or quite to meet (*Cornus florida* Linn., fig. 35; *Cornus paniculata* L'Her., fig. 36.; *Negundo aceroides*, Moench, fig, 18; *Acer saccharinum* Wang.) or if they remain considerably separated from each other (species of *Fraxinus*, *Euonymus atropurpureus* Jacq., fig. 19; species of *Æsculus*.)

III. A third means for further classifying ligneous plants is the character of their winter buds.

1. These may be so situated, either concealed in the substance of the petiole scar itself, or covered by the anterior end of the scar, that the development of these buds towards spring requires the splitting of the scar, or at least a very marked forcing back of the anterior end of the same (*Menispermum Canadense* Linn., fig. 12; *Robinia Pseudacacia* Linn., *Rhus aromatica* Ait., fig. 16.

2. At times the buds are sunk into the bark of the twigs,

but are not covered by the petiole-scars, the flattened tops of the buds scarcely rising above the level of the scar or of the bark of the twig (*Gymnocladus Canadensis* Lam., fig. 31; *Ptelea trifoliata* Linn.). The flattened buds of *Ailanthus glandulosus* Desf. would probably form a closely related class. The remaining more prominently developed scaly buds can be most conveniently classified into:

3. Those which show only one or two scales exteriorly, with perhaps a glimpse of a third or fourth scale but no more (*Smilax hispida* Muhl., fig. 9; *Liriodendron Tulipifera* Linn., fig. 14; *Rhus glabra* Linn., fig. 15; *Diospyros Virginiana* Linn.; *Cornus florida* Linn., fig. 35; *Cornus paniculata* L'Her., fig. 36; *Asimina triloba* Dunal, fig. 1; *Tilia Americana* Linn.; *Lindera Benzoin* Meissner, fig. 33); and

4. Those with typically four or more scales exposed exteriorly. This class can be further subdivided into, *a*, those in which the terminal buds are typically much larger than the lateral buds (*Asimina triloba* Dunal, fig. 21; *Sassafras officinale* Nees; species of *Fraxinus*; *Juglans*, figs. 21, 22; *Carya*, figs. 26–30; *Negundo aceroides* Moench, fig. 18); and, *b*, those in which such a difference if noticeable is not typically of a marked character. In the terminal buds of the first division the exterior scales not uncommonly give more or less evidence of their origin as transformations of leaves. In the cases in which, on dissecting the scaly bud, the scales, with the exception often of the first two, are seen to be evidently metamorphosed stipules (*Liriodendron Tulipifera* Linn., fig. 14; *Fagus ferruginea* Ait.; species of *Quercus*, *Castanea*, *Carpinus*, *Corylus*, and *Tilia*) the list of possibilities is still further reduced. The marked crowding together of buds towards the tips of the branches, as in species of *Quercus*, is often evident enough to be quite characteristic of certain species, but does not serve well as a basis for more general classification.

IV. The manner in which branches are terminated gives a fourth means of distinguishing ligneous plants.

1. Thus the green tips of the newly developing twigs are in certain species cast off each spring, and in the winter-twigs the absence of the terminal bud and the presence of a scar there where the bud ought to be, can always be readily recognized (*Tilia Americana* Linn.; *Catalpa speciosa* Warder;

Ailanthus glandulosus; *Ulmus fulva* Michx., fig. 3). While in many species all, or almost all, of the tips of the branches are thus affected, in others (species of *Æsculus*) only one half the tips of the branches are thus terminated, while the remainder show the usual terminal scaly buds.

2. In other species the tip of the branches shrivels up at a very early date, before summer, but is not cast off, the shriveled tip remaining through the winter (*Diospyros Virginiana* Linn.; species of lilac).

3. Again in other cases the tiny tips are not killed in early spring, but quite a considerable portion of the more developed branch is killed back by the frosts of autumn.

4. Lastly, in the great majority of species, terminal scaly buds are always present.

V. A fifth means of determining ligneous plants is often given by the presence or absence of stipules, as indicated by the scars which remain after they have fallen off. Since these stipules usually fall off early in spring they frequently leave but indistinct scars in witness of their former presence, but a little practice will make the observer quite adept in recognizing even the poorer stipule-scars on the winter twigs. The stipule-scars, when present, may more or less encircle the stem, (*Liriodendron Tulipifera* Linn., fig. 14, or may be considerably separated, as usual (*Tilia Americana* Linn.; *Fagus ferruginea* Ait., fig. 17; *Morus rubra* Linn., fig. 5; *Hamamelis Virginica* Linn.) In certain species the stipules are represented by thorns, as in *Robinia Pseudacacia* Linn., and *Xanthoxylum Americanum* Mill. When these stipular thorns are aborted, as occurs at times in the latter species, the fibrovascular bundles destined to provide them with sap can be detected at the surface of the wood on removing the bark. Most ligneous plants never have stipules.

VI. The presence of thorns in general often provides a sixth means of distinguishing plants. Thorns representing stipules have already been mentioned. They often also represent small axillary branches, usually supplemented by normal leaf buds at their base. The relative position and character of the thorns and leaf-buds is then at times a means of distinguishing species. Thus, in *Gleditschia triacanthos* Linn., the thorn represents the upper of a series of superposed bud, and is often decidedly removed from the subtending

leaf scar; the thorn is frequently branched, and its branches subtended by distinct bracts. In *Crataegus Crus-galli* Linn., the thorn has two lateral buds, of which one exceeds the other considerably in size. The smaller bud usually perishes, the larger one develops, pushes the thorn aside, and in the older parts of the tree the thorn then assumes an apparently lateral position. In *Maclura aurantiaca* Nuttall there is usually a leaf bud on one side, and a long narrow scale with empty axil on the other.

The fact that in certain species the thorns representing branches appear only under abnormal conditions, or first in the older plants, reduces the value of thorns as constant features in distinguishing plants. Many ligneous plants also have thorns which represent only outgrowths of the bark. These are usually irregular in their disposition, but the triple spines of *Ribes Cynosbati* Linn., placed just beneath the petiole-scar is a good instance of the constancy of character and disposition sometimes shown by mere outgrowths of the bark.

VII. A seventh characteristic of ligneous plants is the presence or absence of more or less salient ridges on the bark. These show usually some more or less definite relation to the petiole scars, being frequently decurrent from the latter (*Spiræa opulifolia* Linn., fig. 13; *Cercis Canadensis* Linn. fig. 2; *Euonymus atropurpureus* Jacq., fig. 19). The more or less rounded angles of other plants are also worthy at times of observation, as in the case of the frequently eight to ten-angled stems of *Sambucus Canadensis* Linn., fig. 37.

In addition to these more important characteristics furnished by the annual growth of twigs which can be used in forming a sort of artificial classification of plants, there are others which are very useful in distinguishing the individual species.

The color of the bark of twigs usually varies in shades of brown or gray. When therefore a tree or shrub presents characteristically twigs with bark of a green color (*Negundo aceroides* Moench, fig. 18; *Sassafras officinale* Nees; *Euonymus atropurpureus* Jacq., fig. 19) or of various shades of red or purple, the color becomes a characteristic feature of value. The genus *Cornus* provides a striking instance of the success with which the color of the annual twigs can often be used in

distinguishing species. The little circular ruptures in the bark of *Sambucus Canadensis* Linn., fig. 37; and the milky juice exuding from the broken bark of *Morus rubra* Linn., fig. 5, in warmer weather are also good characteristics.

Again, the pith at times affords good features. Thus in *Diospyros Virginiana* Linn., the place of the pith is usually hollow; in *Gymnocladus Canadensis* Linn., fig. 31, the pith is reddish brown; in species of *Juglans*, fig. 20, and *Pterocarya Caucasica* Kenell, fig. 23, there is a tendency for the pith to separate into transverse plates.

The more special examination of the form of the petiole scars with their intersected fibrovascular bundles, the relative size and form of the scaly buds, the number of scales visible exteriorly, their relative size and form, are features so widely variable in different species, and yet so nearly constant in individuals of the same species, that they furnish often the best means for specific determination. The various figures presented on the accompanying plates give a very good idea of the great importance of these features for specific or at least generic determination.

The preceding discussion will suffice to give an idea of the great variety of features offered by all annual twigs of ligneous plants for the purposes of their identification. For the great majority of such plants they will suffice in determining the species, and in almost all cases there is no difficulty about the genus. Naturally there will be the least difficulty in recognizing species during winter where the flora has been best studied during spring and summer by ordinary botanical methods, and where the range of possible species is therefore very well known.

In addition to these more omnipresent characteristics there are others which are very good if present. Such are for instance the form and character of the flowering buds for next year, whether present in the shape of naked catkins or flower buds or enclosed in more or less scaly buds (*Rhus aromatica* Ait.; *Asimina triloba* Dunal, fig. 1; *Cornus florida* Linn., fig. 35; *Cornus paniculata* L'Her., fig. 36; *Lindera Benzoin* Meissner, fig. 33). The presence of flower buds within the scaly winter buds is often indicated only by the larger size of those scaly buds which contain flower buds as compared with those which contain only rudimentary leaves. It

is evidently often possible to dissect the buds and to make a careful study of the leaves and inflorescence of many species of ligneous plants and at times even of the flowers destined to blossom next year. In other words the ordinary means of botanical determination can to a certain extent be employed. As a matter of practice, however, this was rarely found necessary since the external features were found sufficient for purposes of identification.

The remains of the inflorescence of the last season is another good means of recognizing ligneous plants when this is present, as in the case of the fruited pedicels of *Diospyros Virginiana* Linn., the inflorescence of *Ptelea trifoliata* Linn., *Rhus glabra* Linn., *Ostrya Virginica* Willd., *Cornus florida* Linn. At times even the fruit remains for a large part of the winter, or is found immediately beneath the tree where it has fallen on the ground. The pods of *Hamamelis Virginica* Linn., naturally remain on the tree all winter since they do not ripen until next year.

The bark of the trees usually finds difficulty in accommodating itself to the increased circumference of the tree in its old age, so that it often provides good characteristics at that time for distinguishing species. Thus in the beech the bark remains comparatively smooth; in the sycamore it splits off in flat little pieces; in species of hickory it separates in long shaggy strips which remain more or less attached to the tree; in species of birch the bark separates into more or less thin sheets which wrap horizontally around the trunk of the tree and fall off at times. In the great majority of trees the bark cracks more or less in advanced age and the peculiar cracks thus caused form often very characteristic figures or designs—if this expression be given not too literal a sense—which can be used in recognizing the genera and at times even the species of trees. Old woodsmen use this means of identifying the older trees often with considerable success, although often mistaken in determinations of the younger intermediate trees of the same species in which the cracks are less developed.

And lastly the general habits of a ligneous plant, whether it be a vine or not, the curvature of its branches, and the like often give good characteristics, although the general aspect produced by the method of branching in a young individual and in an old tree may be very different (*Ulmus*).

Of course it must not be expected that winter twigs with their scars and buds will furnish better means of distinguishing closely related species than the ordinary botanical ones. On the contrary they are apt not to be so good. It is very astonishing, however, how successful a means of recognizing species these annual twigs can provide. Thus where species although placed in the same genus show very marked botanical differences in their inflorescence, flowers, and leaves, the characters provided by the winter buds are usually also very well marked. For this purpose the figures here given of the several species of the *Rhus* are very significant—*Rhus glabra* Linn., fig. 15, with its remains of last year's inflorescence; *Rhus aromatica* Ait., fig. 16, with its spikes for next year's blossoming; and *Rhus Toxicodendron* Linn., fig. 7. The figures given of *Cornus florida* Linn., fig. 35, and *Cornus paniculata*, L'Her., fig. 36, are also very suggestive.

On the other hand when the species are more closely related to each other there is greater difficulty in recognizing the species. And yet even then it will be seen that in proportion as the species are found to be more closely related to each other according to ordinary methods of botanical determination, they will also show greater resemblance in the characters presented by the annual twigs. The various species of walnut and hickory show this fact very well as can be seen from the accompanying figs. 20—30, which represent most of the known species. Of course in the case of the willow, where the species are distinguished often by slight characteristics, many of the species can be identified in winter only by the expert, by means of slight characteristics often beyond the power of accurate description. Any one however who will take a glance at the accompanying plates, which present with the exception of a few *Juglandaceæ* only the commoner species from the vicinity of Dayton, Ohio, arbitrarily selected for illustration, will be struck by the facility with which the various species can be recognized. Moreover it will also be seen that even the ordinary observer without botanical training can soon learn to distinguish the various species of his district during winter if he have drawings of typical annual twigs of the various species as a means of comparison.

There are in many states botanical institutions founded for

the purpose of giving practical assistance to people of that state on questions relating to botany, especially questions of practical utility. It certainly seems as though a ready means of distinguishing the ligneous plants of their states would not be the most unwelcome contribution which these institutions could make to the people if the writer can judge from the interest usually awakened among farmers and woodsmen on showing them the various means of readily recognizing the species in winter.

It is therefore believed that the preparation of a set of plates with typical figures of the annual twigs, their scars and buds, of the ligneous plants of different states, would at present be a desideratum, especially if accompanied by critical notes indicating the range of variations within the limits of the same species, and a statement of those characteristics which are most significant in the identification of each species.[1]

In any case the above notes may serve to indicate what features have been found serviceable in the identification of ligneous plants in the winter months during ten years experience and what are their relative importance. Possibly it may also lead some to take an interest in the winter condition of plants who have hitherto confined most of their botanical work to the spring and summer.

Hotel des Thermes, Paris.

EXPLANATION OF PLATES.

The superposed buds are numbered in the order of their appearance and development by Roman numerals. In *Liriodendron*, fig. 14, *s* indicates the point of juncture of the leaf proper with the sheath formed by the stipules. On the exterior sheaths the leaf itself is represented only by a scar. In *Fagus*, fig. 17, *l* indicates the hairy leaf found after the exterior scales have been removed. The two scales on either side are the stipules for this leaf. The figures, except fig. 32, were all prepared in 1883. The date at which they were collected is indicated in each case in abbreviated form. The phyllotaxy is also given, in the form of a fraction. These figures have been chosen because from the large amount of material at hand, *these* have been found to be the most typical also for subsequent years.

Plate XII.—1. Asimina triloba Dunal. *c*. Flower bud. 2 Cercis Canadensis L. 3. Ulmus fulva Michx. *b*, bud subtended by two leaf scars, the latter representing but one leaf in the phyllotaxy; see fig. 32. 4. Celtis occidentalis L. 5. Morus rubra L. 6. Ampelopsis quinquefolia Michx. 7. Rhus Toxicodendron L. Notice how readily this species is distinguished from the last in the winter. 8. Celastrus scandens L. 9. Smilax hispida Muhl. *b*, the bud in the

[1] Just such a work as is here suggested has been in preparation for a number of years by one of our ablest botanists. We have recently inspected the drawings which are nearly completed, and the work will be ready for publication within a few years at most.—EDS.

leaf axil seen from above. *c*, a section of the bud to show the ⅜ phyllotaxy. 10. Viburnum molle Mx. 11. Nyssa multiflora Wang. 12 Menispermum Canadense L. 13. Spiræa opulifolia L. 14. Liriodendron Tulipifera L. *b*, one of the inner stipular sheaths of the winter bud showing a young leaf attached. 15. Rhus glabra L. 16. Rhus aromatica Ait. 17. Fagus ferruginea Ait. *b*, a bud with several scales removed. 18. Negundo aceroides Mœnch. 19. Euonymus atropurpureus Jacq.

Plate XIII.—20 Juglans regia L. Scales of terminal bud less leafy than in other species. 21. Juglans nigra L Buds close to the axils. 22. Juglans cinerea L. Buds usually a short distance above the axil. *b*. A scale of terminal bud. 23. Pterocarya Caucasica Kenell. Peculiar leaf scar. 24. Carya amara Nuttall. Slender buds near the axil. In Carya the figures made by the fibro-vascular bundles are less distinct than in Juglans and often less distinct than here figured. 25. Carya olivaeformis Nuttall. Upper of the superposed buds often remote from the axil. 26. Carya porcina. This and the following species are forms intermediate between the two preceding species with more slender buds and the three following with more oval buds. 27. Carya microcarpa Nutt. 28. Carya tomentosa Nutt. To be distinguished from the next species by its more or less tomentose bark A few scales have fallen off from the bud. 29. Carya alba Nutt. After a few scales have fallen off from the bud. 30. Carya sulcata Nuttall. Buds often clustered at the tip, outer scales with a close appressed pubescence; color, purplish brown, grading to greenish brown. 31. Gymnocladus Canadensis Lam. 32. Fraxinus excelsior L. From the Trocadero Gardens at Paris. Two buds in one axil A single bud in the opposite axil, not seen It is not a case of superposed buds, nor of one bud in the axil of the outer scale of the other, but a case of dédoublement. It is the opposite of that shown in fig. 3, *b*. 33. Lindera Benzoin Meissner. 34. Fraxinus. Species unknown, but both of them believed to belong to Fraxinus Americana. To show variation of scars, which is often great in species of this genus. 35. Cornus florida Linn *a*, flower bud. Notice setting of buds in the tip of the stem; also in *b*, and compare with next species. 36. Cornus paniculata L'Her. *a*, flower bud. 37 Sambucus Canadensis L The lower of the superposed buds, in a longitudinal section of the stem is seen to have its fibrovascular bundles connected at the base with those of the larger upper bud. These fibro-vascular bundles of the lower bud are bent *backwards* from the above mentioned point of junction, in order to reach the smaller bud; this has not been noticed in the case of the other superposed buds examined, where the fibro-vascular bundles are all directed forward.

Two new genera of Hyphomycetes.

A. P. MORGAN.

The following genera of the Mucedineæ or white molds I have had so long and they appear so distinct that I may now venture upon their publication. The first is the only genus of the Didymosporæ in Saccardo's system possessing cylindric spores. The second by its remarkable spores represents a section Dictyosporæ, which is not represented in the Mucedineæ of Saccardo's volume.

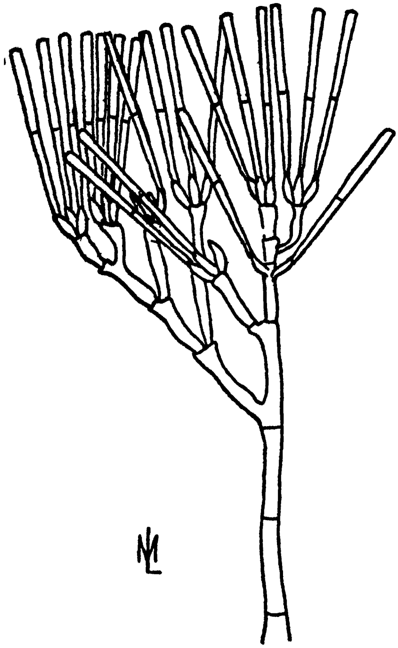


FIG. 1. *Cylindrocladium scoparium* Morgan.

Cylindrocladium gen. nov.—Sterile hyphæ creeping, branched; fertile hyphæ erect, forked or trichotomously branched, the sporophores in pairs or threes at the extremities of the branchlets and cymosely arranged; spores solitary, cylindric, 1-septate, hyaline.

C. scoparium n. sp.—Effused, thin, flocculose, white; sterile hyphæ creeping, slender, indistinct; fertile hyphæ thick, erect, hyaline, septate, cymosely branched above, the sporophores short, disposed in pairs or threes at the extremities of the branchlets, each producing a single spore at the apex; spores cylindric, tapering slightly downward, 1-septate, hyaline, obtuse at each end, 40—50μ in length, 4μ thick at the apex, and 3μ at the base.

Growing on an old pod of *Gleditschia triacanthos.* The sterile hyphæ are abundant enough, but they are fine slender

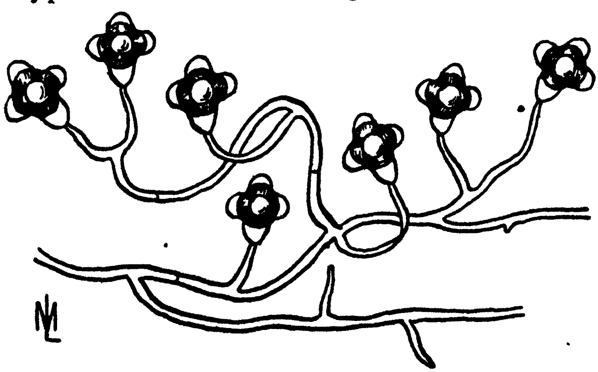


FIG. 2.—*Synthetospora electa* Morgan.

threads creeping close to or beneath the surface; the fertile hyphæ have a simple septate stem 5–7μ in thickness and are

dissolved above into a level-topped cyme of branches; their height, exclusive of the spores which easily fall off, is 125—150μ.

Synthetospora gen. nov.—Hyphæ procumbent, branched, intricate, sending out short lateral fertile branchlets, which produce the spores at the apex; spores lobed, each consisting of a large opaque central cell with several smaller hyaline cells sunk part way into its surface. The genus is a compound Mycogone.

S. electa n. sp.—Effused, thin, flocculose, white, becoming yellowish and pulverulent; hyphæ long, creeping, very slender, hyaline, scarcely septate, branched and loosely interwoven; the lateral fertile branchlets abundant, short, ascending, each terminated by a single spore; spores normally 6-lobate composed of a central globose cell, with a smaller spherical cell at the base, another at the apex, and four cells laterally on the circumference; the spores are 20—30 μ in extent, being usually a little longer from base to apex, the smaller hyaline cells measure 10—12 μ in diameter and project half way or a little more.

Growing on the hymenial surface of some *Peziza*, presumably *P. semitosta* B. & C. The habit and habitat are that of a Mycogone, but the double spore of the latter is greatly amplified. The hyphæ are quite slender, about 3 μ in thickness. The hyaline basal cell by which the spore is attached to the thread is sometimes drawn out to nearly conical; the symmetry of the spores is occasionally interfered with by the interposition of a fifth lateral cell.

Preston, O.

BRIEFER ARTICLES.

The chemical composition of the nectar of the Poinsettia.—The nectaries of *Poinsettia pulcherrima* are strongly developed and secrete so abundantly that the nectar drips away from the organs. From some specimens growing in the college green-house, a considerable quantity of the nectar was secured in very pure condition, by means of a fine pointed camels-hair pencil. It was a clear, colorless sirup, very sweet and becoming sticky on drying.

The total amount collected was 3.383 grams which, after standing some weeks over sulphuric acid, was reduced in weight to 2.3353

grams, or 69.02 per cent. of the original amount. This may be regarded as representing the solids of the nectar. It was transparent and non-crystalline. On being dissolved in water it showed a strongly reducing action toward Fehling's solution, indicating the presence of glucose sugars. In the polariscope a specific rotation of +13.7° was noted, which after inversion became —10.8° showing the presence of cane sugar. From the polariscope data were calculated 11.23 per cent. cane sugar and 57.7 per cent. glucose.

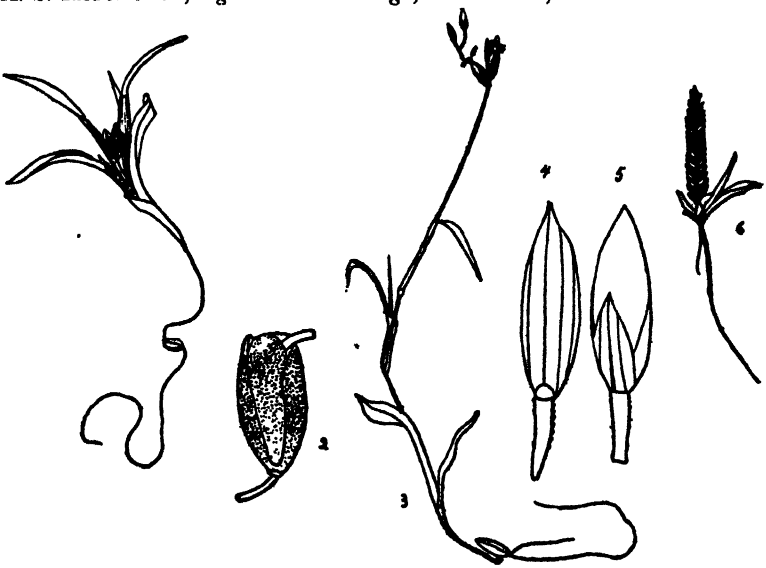
The small amount of material prevented a more extended examination. The composition is expressed very closely by these percentages: water, 30.98; cane sugar, 11.23; glucose, 57.79.

In this connection a late paper by P. C. Plugge (Archiv der Pharmacie *229*, 554) is of interest. Searching for the cause for Xenophon's reference to poisonous honey, he examined the nectar of *Rhododendron pontica* and found that it had a poisonous effect upon small animals. It was not ascertained if bees were harmed by it or not. The poisonous principle was isolated and called *andrometoxin*; it was also found in the nectar of several other Ericaceæ, the honey from which would undoubtedly be poisonous.—W. E. STONE, *Purdue University, La Fayette, Ind.*

Notes on Asclepias glaucescens and A. elata.—Dr. Palmer has just sent in from Colima, Mexico, the true *Asclepias glaucescens* HBK., which necessitates a change of name in our United States species. A. glaucescens was described and figured in Nov. Gen. et Spec. vol. III. p. 190, t. 223, from plants collected between Acapulco and La Venta de la Moxonera. Dr. Gray, in Syn. Flora vol. II. 92, refers the *A. Sullivantii* Torrey Bot. Mex. Bound. p. 162, to this species. The United States species, however, is clearly distinct from A. glaucescens and should be referred to *A. elata* Benth. Dr. Gray, however, in the Syn. Flora, Suppl. p. 401, considered the two the same species, but in the light of this new material I am convinced we have two good species although closely related. A. elata has oblong or oval leaves, rounded at the apex very like A. obtusifolia. A. glaucescens has much longer and narrower leaves, oblong to linear-oblong and acute. The flowers are much larger in A. elata and the hoods are spreading, exposing the gynostegium; in A. glaucescens the hoods are longer instead of shorter than the gynostegium and erect and connivent; there is also a good character in the horns. Dr. Gray describes the form as it is in A. elata (under A. glaucescens in Syn. Flora) where, in speaking of the hood, he says "the whole length within occupied by a broad and thin crest, which is 2-lobed at the summit, the outer lobe

broad and rounded, the inner a short, triangular, subulate, nearly included horn." In A. glaucescens the horn is a broad, triangular, incurved, entire beak.—J. N. ROSE, *Department of Agriculture, Washington, D. C.*

Some depauperate grasses.—A number of small specimens of grasses were observed this spring in the propagating houses of the Horticultural Department. In many cases the seed from which the plant sprung was still attached to the root and showed no signs of decay. Three specimens were selected and drawn; *Setaria viridis* Beauv., *Panicum sanguinale* L., and *Eragrostis major* Host. These are common weeds here and are normally many-leaved and many-flowered, but having germinated in the sand they were forced for self-preservation into the production of seed much sooner than usual.—A. S. HITCHCOCK, *Agricultural College, Manhattan, Kans.*



DEPAUPERATE GRASSES: 1. Setaria viridis, natural size; 2. Spikelet attached to root of same, × 10; 3. Panicum sanguinale, natural size; 4, 5. Spikelet from inflorescence of same, × 10; 6. Eragrostis major, natural size.

CURRENT LITERATURE.

A text-book of bacteriology.

AN EXCELLENT addition to the list of hand books covering the subject of bacteriology, available to the English speaking student, has recently been published by an American firm. It is a translation of the third edition of the admirable work by Fraenkel,[1] which has already been favorably received by European teachers. The author was for a long time associated with Dr. Robert Koch, being in charge of the general laboratory of the Hygienic Institute in Berlin. The translation has been well performed by Dr. J. H. Linsley, and the publishers have put the work into an attractive and seviceable form.

The larger part of the work is devoted to laboratory methods and to the discussion of specific forms of bacteria. After a brief chapter regarding the biology of bacteria, the methods of manipulation, separation and cultivation of bacteria are treated in a particularly clear and serviceable way through nearly one hundred pages. A chapter of considerable length is devoted to the relation of bacteria to animal diseases, including the questions of susceptibility and immunity. The remainder of the book, except a few pages upon the investigation of air, soil and water, and upon yeast and molds, is devoted to specific kinds of bacteria, largely pathogenic.

The work is clearly written, with few or no digressions, and with the needs of the student, particularly the medical student, kept constantly in view. Everything that would divert the attention of the learner is omitted, and so there is no discussion of disputed points, and no citation of literature. Another omission, for which a good excuse is not apparent, is the total absence of illustrations. This sometimes necessitates rather long and uncertain descriptions of apparatus, of which a much clearer idea could be obtained from a cut.

The work is specially designed to meet the needs of the medical student, and it is not surprising, therefore, to find that the author does not take up the general treatment of the bacteria from the botanical or purely scientific point of view. Yet it would scarcely have seemed out of place to have given some hints regarding the usefulness of bacteria in the processes of nature and certainly one could reasonably hope to find some reference to their role in producing diseases of plants. But within the limitations set by the author, the work is most admirably written, and will prove a serviceable book for the laboratory and class room.

---

[1] FRAENKEL, CARL.—Text-book of bacteriology; third edition.. Trans. by J. H. Linsley. pp. 376. roy. 8vo. New York, Wm. Wood & Co.: 1891.

The pyrenomycetous fungi.

One of the most valuable systematic works upon fungi, yet published in this country, has just appeared. It is a thick octavo volume, with descriptions of the species (about 2,500) of North American Pyrenomycetes, including the Perisporiaceæ and Hysteriaceæ, illustrated with forty-one carefully drawn plates. Messrs. Ellis and Everhart,[1] who are also the publishers, have performed the task of gathering, studying and arranging the species of this large order in a manner that must meet the general approval of botanists. The work is more than a compilation, although even that would have been a decided service in the present scattered state of our literature, for the authors have revised the descriptions where needed, added uniform spore and ascus measurements, and looked after the synonymy. The Perisporiaceæ were elaborated for the volume by Prof. T. J. Burrill. The plates were drawn by the late F. W. Anderson, and are very satisfactory.

The methods adopted in the citation of authority for names is of particular interest at the present time. "The name of the author first publishing any species has been retained, placed in parenthesis in case the species has been removed from the genus in which it was first placed. The name after the parenthesis has been omitted as too cumbersome and unnecessary." The name, however, may be easily supplied by the reader, if desired, as it appears in the synonymy which immediately follows. The authors add, that "the piratical practice of omitting the first name and substituting the second in its place can not be too strongly condemned." Anent which we have only to quote Paul's beatitude, "Happy is he that judgeth not himself in that which he approveth."

Probably no one could have undertaken the task of arranging the American species of this order who was so well equipped for the work, both by familiarity with the plants and abundance of material, as the present authors, and it is extremely gratifying that they have produced such a satisfactory volume. It will give a decided impetus to the observation of these fungi, which will doubtless early lead to copious additions to the present work.

The volume would have been made more convenient for ready reference, if a synoptical table of genera, divisional headlines to the pages, and an index of hosts had been provided. There is, however, an excellent species index prepared by W. C. Stevenson, Jr. The volume is substantially and neatly bound.

---

[1] Ellis J. B., and Everhart, B. M.—The North American Pyrenomycetes: a contribution to mycologic botany. 8 vo. pp. 793. pl. 41. Vineland: Ellis and Everhart, 1892.—$8.00.

Two books on elementary botany.[1]

MISS NEWELL's earlier volume treating of the vegetative parts of plants was favorably commented on in this journal at the time of its appearance several years ago. The present part treating of the flower and fruit is quite up to the mark of its predecessor; and as the subject it deals with is much more difficult to handle, that is to be taken as high commendation.

The book commences with a study of the bulbous plants that are commonly raised in the house, such as the tulip, hyacinth, crocus and snowdrop. From these the student is led to the earlier spring flowers, the forest and shade trees, the later spring and early summer flowers. In the treatment of each topic there is a combination of morphology and biology with taxonomy, which will strike most people as judicious, while the more radical will say that the taxonomy would better have been left for later study. The author is evidently escaping from the shackles of the older organography, as the mixture of the older and the more modern ideas and expressions indicates. To cite a single instance: On page 19 we are told that "Anthers are generally two-celled." On page 59: "Anthers are generally two-lobed, or as they are called, rather incorrectly, two-celled"; and in a footnote the real structure of the anther is explained. Errors are unusually rare and this alone is a strong commendation when so many of the elementary books seem to be written by persons who do not know whereof they speak. The plants themselves and the difficulties young pupils are most likely to encounter are evidently intimately known to the author. We do not know a book which is better adapted for its purpose than this one, and can most heartily recommend it to those whom its title addresses: "teachers, and mothers studying with their children." The illustrations are from the pen of Miss H. P. Symmes, and although there is something of technique to the desired in their execution, they exhibit much artistic feeling and essential accuracy.

THE OTHER BOOK is of wholly different sort, not only in the way in which the subject is treated, but also in its quality. Miss Aitken has essayed to produce an "elementary text book of botany for the use of schools."[2] It is divided into three parts, the first being designated "Outlines of the external morphology and classification of flowering plants"; the second, "Description of some typical non-flowering plants

---

[1]NEWELL, JANE H.—Outlines of lessons in botany for the use of teachers, or mothers studying with their children. Part II: Flower and fruit. 12mo. pp. vi. 393. Ginn & Co., Boston: 1892.

[2]AITKEN, EDITH.—Elementary text-book of botany for the use of schools. 12mo. pp. xiii. 248. figs. 131. Longmans, Green & Co. London: 1891.

or cryptogams; the third, "General description of flowering plants." Under the first part is given a very brief organography, which is not at all accurate, followed by descriptions of single members of the more important orders, from which pupils are supposed to derive a "typical example" for the purpose of "grouping exceptional forms around the central type, to which in memory one should always return." We very much doubt the wisdom of such a plan, and its execution leaves much to be desired.

In the two succeeding parts the author is endeavoring to follow the pattern of Huxley and Martin's Biology. As it seems to us, however, she has neglected the most essential feature of their plan, viz.: the preparation of specific directions for the "practical work" of the student. The headings of this sort in this book do not cover any directions that will be of use to the student. The "practical work" follows a description of the plant. Under Funaria for instance, one reads, "Examine specimens of Funaria, and verify the facts mentioned above." Here are others: "Cut sections of the stem and observe the different kinds of cells." "In older specimens examine the sporogonia." It is quite certain also that many of the directions, particularly in physiological parts, have not been put to the test; else their impracticability would have been discovered. The figures, except those from other works, are poorly drawn for photo-engraving and consequently very blotchy. Altogether, so far as American schools are concerned, Miss Aitken has contributed nothing of educational value.

Minor Notices.

IN A RECENT NUMBER of *Education* Professor Conway MacMillan has a vigorous criticism of the current methods of botanical instruction. Mr. MacMillan is radical and has at command an expressive vocabulary. The paper is worthy the attention of every teacher who can correct his own work thereby or who can influence others to do so. We should like to quote more than this sentence had we space: "The whole course in 'botany' is so planned that at its close the pupil may practice a few diagnoses, may apply a few binomial names and may gather a collection of pressed flowers which are pasted carefully in a synopsis book—such as certain misguided persons have been unable to refrain from publishing—and the whole unfortunate affair is dignified as a herbarium and is afterwards filed away upon some garret shelf, while its owner does not scruple, when questioned, to admit that he has 'had botany.' And he does not think very highly of it either."

IN THE PROCEEDINGS of the Biological Society of Washington for May 18, 1892, Mr. F. V. Coville describes, in advance of the full report of the collections of the Death's Valley expedition, several new species from that interesting region.

THE REPORT of the Royal Botanic Gardens at Trinidad for 1890 has been distributed. The report shows the work of the gardens in economic and scientific lines. Much attention is being given to the encouragement of the growing of fruits and fiber plants in the island. The illustrations are Messrs. Sprague's well-known "ink-photos" which almost equal the American "half-tone." The form of the report would be much improved by a change from folio to octavo. The Superintendent, Mr. J. H. Hart, working no doubt under many difficulties, is evidently active in promoting the interests of the garden.

OPEN LETTERS.

A botanical congress and nomenclature.

At a meeting of the Botanical Club of Washington, held April 23, 1892, a committee was appointed to consider and report upon the questions of botanical congress and nomenclature. At a special meeting called May 7, this committee presented the following report which was unanimously adopted by the club:

"Your committee, appointed to consider the questions of a botanical congress and botanical nomenclature, held a meeting on the second of May and prepared the following resolutions:

"*Resolved*, That, while favoring the final settlement of disputed questions by means of an international congress, we do not regard the present as an opportune time, but we recommend the reference of the question of plant nomenclature first to a representative body of American botanists

"We suggest the consideration, by such body, of the following questions, among others: the law of priority; an initial date for genera; an initial date for species; the principle once a synonym always a synonym; what constitutes publication; the form of tribal and ordinal names; the method of citing authorities; capitalization.

"We recognize the Botanical Club of the A A A. S. as a representative body of American botanists and commend to that body for discussion and disposal the subject of nomenclature as set forth in these resolutions.

"Respectfully submitted,

LESTER F. WARD, GEO. VASEY, F. H. KNOWLTON, B. T. GALLOWAY, ERWIN F. SMITH, GEO. B. SUDWORTH, FREDERICK V. COVILLE. *Committee.*"

It was voted that a copy of these resolutions be communicated to the BOTANICAL GAZETTE, *Torrey Botanical Club*, *Garden and Forest* and *Science*.—L. H. DEWEY, SEC'Y, *Washington, D. C.*

---

1 Berichte der deutschen botanischen Gesellschaft: x. 27.

NOTES AND NEWS.

M. Casimir Roumeguere, editor of the *Revue Mycologique* died recently at his home in Toulouse.

The director of the botanical gardens of Palermo, A. Todaro, died on the 18th of April last. His successor is Dr. Hermann Ross.

Dr. Eduard Regel, director of the Imperial Botanical Garden at St. Petersburg died on the 27th of April, at the age of 77. He has been director of the St. Petersburg garden for nearly 40 years.

The claims of *Ulota Ameriacna* to autonomy are discussed by Dr. G. Venturi in a recent number of the Revue Bryologique, where he also considers several forms of American Orthotricha collected by Röll and others in the northwest.

The summer classes in botany at Martha's Vineyard, under the instruction of Mr. Edward S. Burgess, will be held this year as usual, meeting from July 11 to August 12. Courses in structural and systematic botany and in histological botany will be offered.

Dr. A. Zahlbruckner has examined the changes proposed in certain genera of lichens by Kunze in his already notorious Revisio Generum Plantarum. Two of the names proposed are accepted; two are to be replaced by others of earlier date; and two, in spite of their priority, cannot be accepted, as they do not coincide with the modern genera.

Mr. M. C. Cooke announces a handbook of Australian fungi of 500 octavo pages and thirty-six partly colored plates. It is published under the authority of the several governments of the Australian colonies, and only eighty copies are reserved for sale in Europe and America. The price is thirty shillings (about $7.50). It may be ordered from the author.

The third annual banquet in memory of Henry Shaw was given by the trustees of the Missouri Botanical Garden at the Mercantile club in St. Louis on May 19. About eighty-five guests, of whom fifteen were from other places, sat down to tables most beautifully decorated with orchids, cut flowers, potted plants and smilax. After an elaborate and elegant dinner, addresses were made by Dr. J. D. Butler, of Madison, Wis., Revs. Stimson and Snyder, of St. Louis, and D. C. Hart Merriam, of Washington. Chancellor Chaplin, of Washington University, presided.

A series of 15 lectures and field meetings will be held at the Arnold Arboretum during May and June for the purpose of supplying popular instruction about the trees and shrubs which grow in New England. They began on Saturday, May 7th, and will close June 25th. They will be conducted by Mr. J. G. Jack. After a review of the plants to be especially observed during the meeting the class will adjourn to the plantations and the nurseries of the Arboretum for an informal study of the plants themselves. An hour and a half to two hours will be devoted to each meeting. An autumn course of fifteen meetings will be given from September 7th to October 26th. This course will give an opportunity for studying many of the trees and shrubs in fruit, their autumn foliage, and their buds and general appearance as they prepare for winter.

BOTANICAL GAZETTE

JULY, 1892.

On the genus Lindbladia.

GEO. A. REX.

The genus Lindbladia of the Myxomycetes, is represented by a single species only. This species, *Lindbladia effusa* (Ehr.) Rost., has a wide range in the United States, having been found in one or the other of its forms in several of the middle and western states. The genus and species have been described by Rostafinski as follows:

LINDBLADIA Fr.—Æthalium naked, composed of numerous irregularly polygonal, minute sporangia with the walls grown together; surface to the extremities of the sporangia warted. —Rtfki. Mon. 223.

LINDBLADIA EFFUSA (Ehr.) Rostfki.—Æthalium naked, seated on a common, strongly developed hypothallus; cortex when prematurely dessiccated black, thick, brown, lustrous, with the surface rough; mass of spores brown-ocher or umber; spores bright colored, smooth .0058–.0072 mm. diam.—Rtfki. Mon. 223. Cooke, Myxomycetes of Great Britain.

Unfortunately the brief diagnostic description of Rostafinski as given above, and also in the *Sylloge Fungorum* of Saccardo, only covers in reality a comparatively small portion of the forms which are legitimately included within the limits of the species. The explanatory notes, however, which accompany this diagnosis in the *Monografia Sluzowce*, give a supplementary description of the more complex æthalioid forms, to which belong a large portion of the American specimens of Lindbladia, and also such European specimens as I have had the opportunity of examining.

An analysis of all American specimens will show a surprisingly varied series of forms, all of which may be properly classed under the one species. Although these are different in their external appearance, they possess the same morphological details.

In addition to the true æthalioid forms described by Rostafinski and others, a form with simple sometimes substipitate sporangia is found in all sections of the northern United States, which, for many reasons, is worthy of varietal distinction. It may be described as follows:

Var. **simplex** var. nov.—Sporangia simple, gregarious, either free and separate or crowded and touching each other but with the walls not grown together; standing in effused clusters on a common hypothallus; elongated ellipsoidal in shape or distorted by crowding; usually either sessile with a narrow base, or substipitate attached to the hypothallus by a black plasmodic point of attachment, or occasionally stipitate with well marked short brown-black rugose stipes; entire sporangia averaging one mm. in height. Sporangium walls simple, sometimes lustrous, often having a few longitudinal folds in their lower half, pale umber colored, roughened externally by being thickly studded with rounded dark-brown plasmodic granules; spores in mass pale umber colored, from 5.5—7.5μ in diameter, with thin epispores very delicately warted but apparently smooth under lenses of medium power.—*Perichæna cæspitosa* Pk.; no. 2,700 N. Am. Fungi, E. & E.

Common in the northern and western states. Stipitate form found in Shawangunk Mts., N. Y.

The occurence of stipes in this variety of the species, which has hitherto been described as æthalioid only in character, is a point of great interest.

Undoubtedly, the extreme forms of the species are apparently very diverse, there being a great range between the simple variety above described and the thick effused æthalia often found, although the area of hypothallus covered by the sporangia is as great in one case as in the other.

The morphological characters common to all these forms, however, are so positive that it is not possible to separate even the extremes by a valid specific distinction.

The æthalia vary greatly in thickness and structure, and may have either a naked or corticate surface. The simplest form of æthalium is composed of irregular or polygonal sporangia, standing in a single rank on a common hypothallus, with the lateral walls grown together, the upper surface being roughened with the dark brown plasmodic granules. These simple æthalia grade into other and more complex forms of æthalia, which grow in effused or sometimes hemispherical

patches often three quarters of an inch thick, and in the first case many square inches in diameter. They are formed of entangled or interwoven masses of elongated or branched sporangia with the walls grown together.

Some of these æthalia have the upper surface irregular and naked, formed simply of the convex apices of the component sporangia. Others have a nearly plane upper surface composed of a thick cortex, developed from and upon the apices and external portions of the sporangia. The special character of the æthalia, whether naked or corticate, seems to be determined by environment or by conditions affecting the plasmodium during its differentiation into sporangia. It is not in any degree dependent upon the size of the mature æthalium, for I have seen both of these forms of the maximum thickness attained by the species.

The spores of all forms, simple and æthalioid, are identical, being delicately warted under high power lenses. The hypothallus of all forms and the cortex of the corticate æthalia are composed of thick plasmodic membranes containing irregular particles of plasmodic refuse.

The hypothallus has an irregular laminated structure, composed of a varying number of thin membranous layers. In the simple variety it is a nearly uniform membrane being at most composed of but two or three layers. In the æthalia however the layers are numerous, not closely touching each other at all points, but separated at intervals, leaving sometimes quite large and wide interspaces which give the hypothalli a loose open structure. In the hemispherical æthalia it may form a sponge-like expansion of one-quarter to one-half an inch in thickness, upon which the branched and interwoven sporangia are erected.

The plasmodic colored granules which are found in the sporangium walls of all specimens of Lindbladia, are exceedingly interesting when examined under a high power lens, and are worthy of careful study. The exterior walls of both the simple variety and the naked æthalia, are thickly studded with these granules which are deeply colored with a violet-brown pigment. They are irregularly spheroidal in shape, averaging about 1.15 μ in diameter. They are composed of a plasmodic investing membrane continuous with the wall of the sporangium, which encloses a rounded nuclear mass also plasmodic in structure, but of a different density and refractive quality.

They project outwardly from the sporangium wall and are attached to its outer surface so slightly as to be readily broken off, leaving a ring-like base, thus giving the membrane of the wall the appearance of being covered with minute elevated annular markings or sculpturings.

Plasmodic granules similar in structure, but flattened and unpigmented, having been modified by their conditions, are found imbedded in the septa or dividing walls between the component sporangia of all the æthalioid forms, corticate as well as naked.

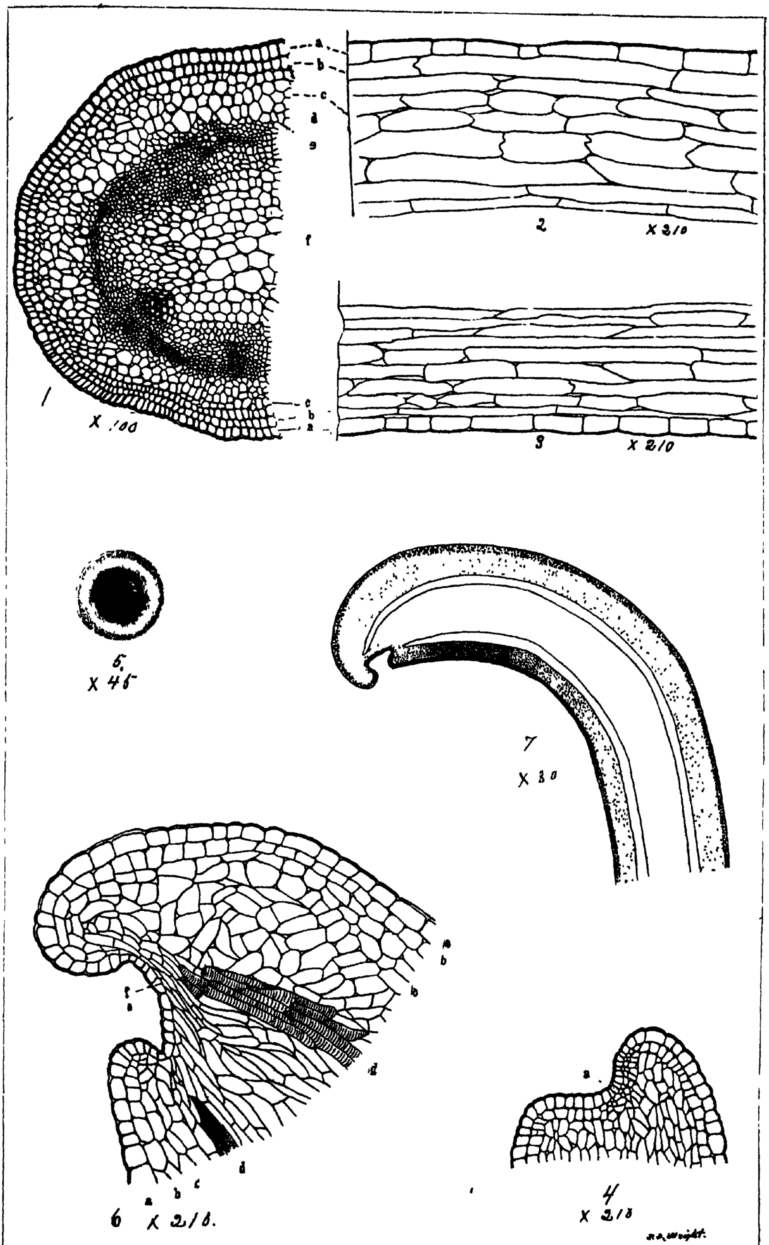
The various reagents which may be used in the preparation of the sporangium wall for microscopic examination, as for instance, alcohol and acidulated water, or the glycerine media used for permanent slide-mounts, will also develop the same annular markings, by softening and disintegrating the thin investing pellicle of the granules, thus freeing the denser nuclei which are comparatively unaffected by the reagents. This fact suggests the possibility of error in conclusions drawn from examinations made from mounted material only.

The natural relations of closely allied genera to each other will always prove an interesting and profitable subject for study, and the relations of Lindbladia and Tubulina, both genera belonging to the same order, LICEACEÆ, will serve as a striking illustration of this point.

The genus *Tubulina* shows an analogous and nearly parallel course of development to Lindbladia, in a series of forms also beginning with simple, separate, aggregated sporangia on a common hypothallus, and extending through various similar æthalioid forms; always however having the sporangia in a single rank, and finally even developing in some instances a partial cortex. At one point of the parallel development of the two series, the analogy is so great that the corresponding forms, if considered by themselves, would be properly classed as species of the same genus, the generic characters being so similar.

Yet Lindbladia, especially through its simple variety, more nearly resembles in some important structural characters the order HETERODERMEÆ through its genus *Cribraria*, than it does the analogous genus Tubulina of its own order.

These special points of correspondence are first, the existence of plasmodic colored granules throughout the whole



MacDOUGAL on TENDRILS.

genus Cribraria (in common with the rest of the Heterodermeæ), similar in construction to those of Lindbladia except that they are permanent and not evanescent under the conditions above detailed ; second, the similarity of the sporangia of at least one species, *Cribraria argillacea*, with its practically permanent wall, to those of the stipitate and substipitate forms of Lindbladia effusa var. simplex.

It is, therefore, a legitimate inference, that Lindbladia and Tubulina, although they closely approach each other, having been similarly developed along parallel ordinal and partially parallel generic lines, probably arose from independent and perhaps widely separated points of origin.

Philadelphia, Penn.

The tendrils of Passiflora caerulea.

D. T. MAC DOUGAL.

(WITH PLATE XIV)

I. Morphology and anatomy.

The work recorded in this first paper was undertaken for the purpose of determining the factors in the movements of the tendrils of the Passifloræ, more particularly the movements by which a tendril responds to a stimulus, resumes its original position, or on continuance of the irritation coils permanently, and its subsequent changes while coiled and serving as a support for the weight of the adjacent part of the plant body.

Accepting as entirely tenable the view that the other movements of the tendril are the results of conditions of growth and varying states of turgescence, they will be considered only in so far as they affect the coiling of the organ. With this end in view, attention will be directed to the arrangement of the tissue systems, their relative mechanical value as determined by the structure of the individual cells composing them, the continuity of the protoplasm between cells of similar and dissimilar tissues with reference to the irritability and power of conducting impulse of the parts concerned, and to the physiological changes induced in the motile cells by the stimuli to which this organ responds.

The first investigations on the nature of tendrils of which we have any record are those of Palm[1] and Mohl[2] published within a few weeks of each other in 1827.

The descriptions in these works are necessarily very meager; the one dealing with the subject from a physiological standpoint while the other reasons from the structural characters alone.

In 1858 Prof. Asa Gray published his paper on the movements of the tendrils of the cucurbitaceous plants [3] which led Darwin to undertake a series of observations which he finally extended to more than one hundred species, the results of which were published in the Journal of the Linnean Society 1865. [4]

Hugo de Vries in his "Zur Mechanik der Bewegung von Schlingplanzen"[5] deals chiefly with the difference of growth of the upper and lower sides of tendrils and the mechanism of movement of twining plants. All of these workers were concerned chiefly with the outward phenomena of movement rather than morphological changes and structural condition. Contemporaneous with these observers and later, much notable work has been done on the organogeny, structure and physiology of tendrils.[6]

To determine the conditions prevailing in the tendril during its period of sensitiveness it was thought necessary to study

---

[1]PALM: Ueber das Winden der Ranken. [2]MOHL: Ueber das Winden der Ranken und Schlingpflanzen.

[3]Proc Amer. Acad. of Science and Arts.

[4]Climbing plants.

[5]Arbeiten des botanischen Institut in Würzburg, 1873, Band I. Heft 3

[6]BRAVAIS BROTHERS: Annales Sc. Nat. 2 Sér., 1837 —ST. HILAIRE: Leçons de Bot. p. 170. 1841.—DUTROCHET: Comptes rendus. tom. 17 p. 989, Des mouvements revolutifs spontanes, 1843 —SACHS Lehrbuch der Botanik; Physiology of Plants. —WYDLER: Flora 1853, Pringsheim's Jahrb. 1878, tome 2, page 317.—FRITZ MUELLER: Journal of the Linnean Society, vol. 9.—DE CANDOLLE: Bulletin de la Soc. Bot. de France, 1857 —LEON: *ibid* tom. 5, p 680, 1858; Gardeners Chronicle 1864, 721, quoted from Darwin.—MCNAB· Trans Bot Soc. Edinburgh, vol. 2, page 292.—LOTAR: Essai sur l'anatomie comparée des Cucurbitacèes, Lille, 1871.—SCHWENDENER: Das mechanische Princip im anatomischen Bau der Monocotylen, 1874.—EICHLER: Blüthendiagramme, 2 vol. 1879.—DUTAILLY: Assoc. franc. pour l'Avanc. des Sc., 8 session: Recherches sur les Cucurb. et les Passiflores, 1879.—HABERLANDT: Physiologische Pflanzenanatomie.—VINES: Physiology of plants, 1886; La Sensibilitie et la motilitie.—MORREN: Des Veg. Bruxelles 1885 p. 52.—OTTO MUELLER: Untersuchung über die Ranken der Cucurbitaceen, 1886, in Cohn's Beitræge zur Biol der Pflanzen —PENHALLOW: Mechanism of movement of Cucurbita, Vitis, and Robinia. Proc. Roy. Soc. Canada, vol. 4, sec. 4, 1886.—PFEFFER: Zur Kenntniss der Kontaktreize; Untersuchungen aus dem bot. Inst zu Tübingen, Band I, 1885.—RUSSELL: Recherches sur la Vrille des Passiflores: Bulletin de la Soc. Bot. de France, 189, 1890.—MASTERS: Trans. Linnean Soc., 1878, p. 317.

its development through all stages of growth from the time of its appearance as an axillary papilla till it passed out of the sensitive stage. During the latter periods of growth sections could easily be made with the aid of pith and a common hand clamp and the collodion embedding method,[7] while in the younger stages a modification of the paraffin methods given by Moll, Campbell and Andrews in the BOTANICAL GAZETTE[8] was found to be more satisfactory.

The greatest difficulty, however, was experienced in fixing and hardening the material. The whole organ is in a state of extreme tension and the contact of any reagent on the sensitive concave surface will, unless it has sufficient strength and penetrative power to kill and fix the protoplasmic body instantly, cause the tendril to roll up in a helix, and the form of the wall and contents of the motile cells would be much distorted. A wide range of reagents was tried with but partial success in any case. Alcohol in strengths varying from 1 per cent. to 96 per cent. was found to be useless, as also corrosive sublimate. Potassium nitrate was found to give the best results in a 4 per cent. solution, but caused the organ to form an open helix. Chromic acid distorted the protoplastic structure besides rendering the sections difficult to stain. Schulze's chrom-acetic-osmic solution was useful only in tendrils less than 2 mm. in length. A mixture of one part distilled water and one part saturated solution of bichromate of potassium retained the structures fairly well in many cases, as did also weaker solutions of the same.

By far the best results were obtained by the use of acetic alcohol of the following composition: 1 part glacial acetic acid; 6 parts absolute (or 96 per cent.) alcohol; 3 parts chloroform.[9]

The tendril must be carefully cut from the stem with the least possible jarring and avoiding all contact with the sensitive lower surface, and then placed in the fixative which must be in a vessel of sufficient dimensions to receive its entire length in a horizontal position. The action of the fluid will cause it at first to curve slightly, and then to regain its former position. After two or three oscillations of this sort it will regain and keep nearly its original form. After remaining in this fluid for a time varying from 20 to 30 minutes, it was re-

[7] Proc Am Soc of Microscopists, 1890 THOMAS Botanical Gazette, Nov 1890.

[8] January and June, 1888; July, 1890

[9] LEE: Microtomists Vademecum, 1890

moved, cut into convenient lengths and placed in 96 per cent. alcohol which was changed several times to remove the acid.

Sections were made with a Cambridge rocking microtome, fastened to the slide in series and after the removal of the paraffin stained in a hæmatoxylin-eosin mixture of the following composition: distilled water, 5 parts; hæmatoxylin (Delafield's) 3 parts; eosin (watery solution) 2 parts. The sections were allowed to remain in the staining fluid 20 minutes. After dehydrating and clearing they were mounted in Canada balsam dissolved in oil of cajeput. The differentiation afforded by this stain can hardly be excelled. The nuclear structures take a dark purple color while the remainder of the cell contents and the walls take on various shades of red according to density.

The tendrils of Passiflora cærulea are filamentous organs springing from the axils of the leaves, often reaching a length of 30 cm., tapering from a diameter of 2 mm. at the base to 1 mm. at the tip before coiling. When 1–3 cm. in length the whole surface often has a reddish purple tinge due to color bodies in the subepidermal cells. With growth the color becomes less vivid and is distributed over the surface in ill defined longitudinal bands. It often disappears entirely from the lower surface, being hidden by the deeper tinge of the chlorophyll.

The tendril makes its appearance as a cone of meristem tissue on the side of the growing point in the axil of a leaf. Shortly after its appearance while it is yet less than .5 mm. in length, there is formed on its summit an irregular cup-shaped depression (fig. 4) by reason of the excessive growth in length of the periblem, that of the upper side being greater. The continuance of this unequal growth causes the cup in the full-grown tendril to become lateral (fig. 5). About the time the cup has assumed the form in fig. 4, spiral vessels make their appearance just below it, followed by companion and sieve cells. The point of most rapid growth passes backward with the elongation of these fibrovascular elements until at the time of coiling it is found at a short distance below the middle of the organ.

When the tendril has reached this stage three distinct regions may be distinguished: the base or non coiling part, 3–4 cm. in length; the middle region or coiling portion comprising the greater part of the organ, which is generally slightly curved; and the sharply curved or hooked tip, 4–6

mm. in length. These three regions show some well marked differences in structure and outline. The whole organ shows a bilateral organization which is least apparent in the base and most pronounced in the portion having the greatest power of movement, a recognized correlation given by Dr. Otto Müller.[10]

The basal portion is broadly oval in outline with just a trace of flattening on the lower side; the middle portion is oval with its lateral much greater than the transverse diameter, while the lower surface is distinctly flattened. The tip is nearly circular in outline, and bears at its extreme end the cup-shaped formation above mentioned. Along the convex upper and lateral sides of the tendril are several obscure angles which are mostly absent from the lower concave surface.

The internal structure of these parts shows corresponding differences. The arrangement in the middle portion is as follows: The epidermis consists of a layer of rectangular cells with the longest diameter parallel to the long axis of the tendril (figs. 1, 2, 3, *a*). Occasional stomata are found distributed equally over both surfaces.[11]

Beneath the epidermis is a layer of collenchyma with thickenings so disposed that that the tangential are much heavier than the radial walls (figs. 1, 2, 3, *b*). Scattered through this tissue are the color bodies mentioned above. At the obtuse angles of the tendril this layer is three cells in thickness, at other places it decreases to one.

Internal to this is a layer of loosely arranged thin walled parenchyma of varying size, containing in the outer rows of cells an abundance of chlorophyll and protoplasm (figs. 1, 2, 3, *c*). The inner rows of cells bordering on the bast are richly loaded with starch, constituting the starch layer of Sachs.[12]

Through the entire layer are occasional crystals of calcium oxalate. The cells of this layer on the convex side are uniformly larger than those on the concave side, leading to a corresponding difference in thickness of the layer. The in-

---

10 "Soweit also die Ranke central gebaut ist, zeigt sie kein Krummungsvermögen: soweit sie bilateral gebaut ist, soweit betheiligt sie an den Einkrummungen." l. c., p. 120.

11 PFEFFER: Zur Kenntnis der Kontaktreize, Par. 9.

12 Physiology of Plants, p. 358; STRASBURGER: Das botanische Practicum, p. 132.

tercellular spaces are large and plentiful by reason of the peculiar manner of junction of conical ended cells. In many cases, however, the entire ends of adjacent cells are pressed closely together, presenting the phenomenon (seen in figs. 2 and 3, *c.*) of one cell sending a protrusion into the cavity of another. It is evident that these cells by both structure and arrangement are well fitted to undergo great variations in size, while the large intercellular spaces, affording plentiful space for the reception of expelled cell sap, make possible rapid changes in the tension of this tissue. The parenchyma is connected with the central pith by medullary rays, two to four cells in height, in the region of secondary growth.

Immediately internal to the starch sheath is the bast region consisting of thin walled, closely packed cells, containing a large amount of dense protoplasm. These are in a condition of rapid growth which gradually becomes less active as the tendril approaches maturity, when they take on excessive wall thickenings, in a manner very similar to that of Cucurbita (fig. 1, *d.*).[13] When the tendril has only reached a fraction of its length this tissue has formed a continuous band interrupted only by the medullary rays.

About the time of maturity the cambium makes its appearance and soon forms a ring of secondary growth on the inner side of the bast, and retains its activity even after the coiling. The primary xylem elements (fig. 1, *e*) are about ten in number; half are disposed in a nearly straight row across the concave side, while the remainder are in an approximate semicircle to conform to the outline of the convex side. Each bundle consists of two or three spiral vessels arranged radially (with generally an annular vessel placed axially), which show marked lignification even in the immature organ. The formation of secondary bundles takes place in such manner on the concave side that a continuous band of wood is formed here, while the xylem elements of the other side retain their individual character until after coiling. The central pith is composed of large parenchyma cells containing some protoplasm.

The basal portion differs from this in its regular oval outline, symmetrical arrangement of the xylem, heavier thickening of the collenchyma, and early formation of a continuous distinct cambium zone. Lignification has extended slightly

[13] PENHALLOW: Proc. Roy. Soc. Canada, vol. 4, sec. 4, 1886, p. 54.

to the pith, and parenchyma in the xylem, which has three or four spiral vessels besides an annular vessel in each bundle. The central pith is generally found torn apart forming the lysigenetic intercellular spaces of De Bary.[14]

The structure of the tip, however, is widely different from that of either of the regions just described. Near the extremity of the concave side may be seen the oval aperture of the cup formation lying transversely to the length of the tendril, appearing white because of the absence of chlorophyll in the tissues beneath. The cavity is .3–.4 mm. across in a direction parallel to the long axis of the tendril and about .8 mm. in a transverse measurement, with a depth of .5 mm. (fig. 6, *e*). The epidermal cells of this region become smaller toward the extremity and are smallest on the floor of the cavity (fig. 6, *a*, *a'*). The collenchyma is composed of one row of shortened, strongly thickened cells terminating at the rim of the cup (fig. 6, *b*, *b'*).

The chlorophyll layer undergoes no changes on the concave side except a slight reduction in size and an increased density of the protoplasm, a feature common to the region except certain cells near the cup. The parenchyma layer of the convex side is relatively very thick, and is composed of very angular, much distorted cells, many of which have their long diameters perpendicular to the surface as seen in fig. 6, *c*.

The bast and cambium decrease in size and disappear entirely shortly after they enter this region. The scattered bundles of xylem of the convex side and the band of the concave side converge as they near the cup and are separated only by a thin spindle of pith. The termination of the tracheary tissue is marked by a mass of epithema,[15] composed of long, slender cells with oblique ends, appearing as a continuation the tracheæ, and touching directly the epidermal layer of the cup without the intervention of the collenchyma layer.

All the tissues of the tendril are abundantly supplied with pits, especially the parenchyma of the pith and cortex, which have numerous simple pits, oval in form, arranged transversely, with the torus present. The inner side and radial walls of the parenchyma of both the concave and convex surfaces communicate with the adjacent cells by similar structures; those of

[14] Comparative Anatomy of Phanerogams and Ferns, Eng Ed., p. 200.

[15] De Bary: Comp. Anat. of Phanerogams and Ferns, Eng. Ed., pages 375–376.

the collenchyma being most numerous on the tangential walls. The markings of fibrovascular elements are of the common form in this type of plants. The arrangement of the protoplasmic body of the organ with reference to density and composition, bears a direct relation to the sensitiveness of any part of the organ. The protoplasm is most dense and richly granular in the epidermis and chlorophyllous cells of the concave surface near the tip. The density decreases as it passes back into the middle region where it is quite uniform throughout. The contents of the epidermal cells and collenchyma of this side take the stain most deeply as does the epidermis of the convex side, which, as well as the underlying tissue, is very similar over the entire surface.

It may be assumed in conclusion, that the concentration of the protoplasm in the epidermal layer has a direct connection with irritability, that the movements of the organs are due to changes in the chlorophyll layer and that the disposition of the xylem elements is favorable to rapid flexion and extension, and that the abundant supply of reserve food material is a provision for the rapid growth and fixation of the tendril upon coiling.

Purdue University, La Fayette, Ind.

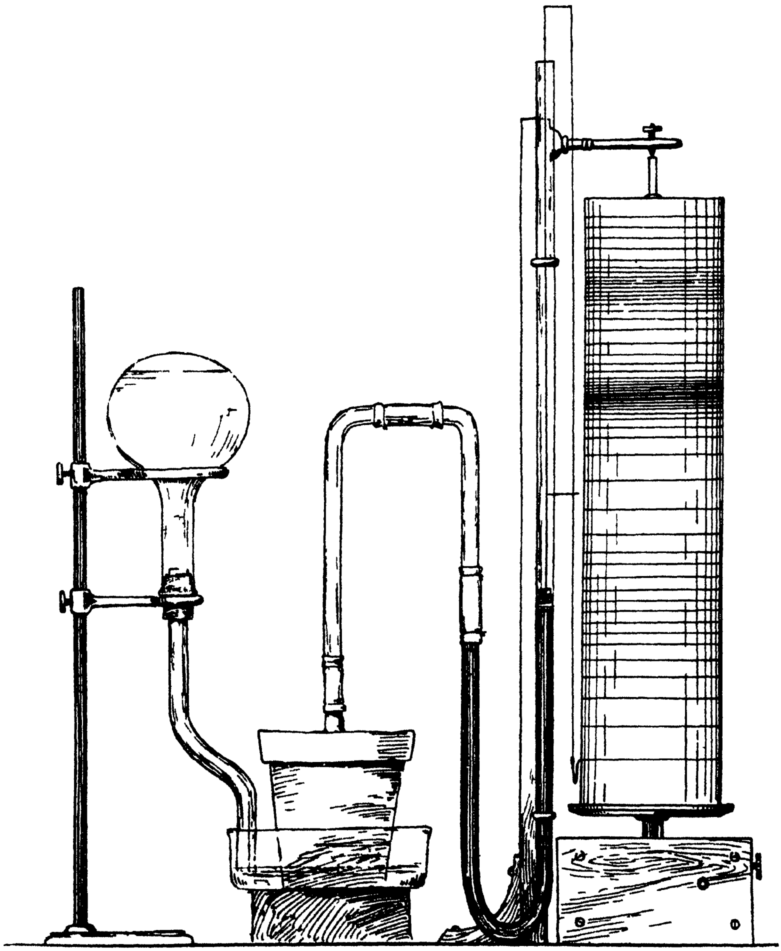
EXPLANATION OF PLATE XIV.—Fig. 1 Half cross section of middle portion of tendril.—Fig. 2. Longitudinal section of convex side of same.—Fig. 3. Longitudinal section of concave side of same. *a, a'*, epidermis; *b, b'*, collenchyma; *c, c'*, chlorophyll parenchyma; *d*, bast; *e*, xylem; *f*, pith.—Fig. 4. Longitudinal section of tip of tendril showing cavity, *a*.—Fig. 5. Cavity of same seen from end.—Fig. 6. Longitudinal section through tip of mature tendril. *a—d*, same as in fig. 1; *e*, cavity; *f*, epithema.—Fig. 7. Diagram showing distribution of protoplasm in tip and part of middle region of tendril.

An apparatus for determining the periodicity of root pressure.

M. B. THOMAS.

(WITH PLATE XV.)

The study of the periodicity of root pressure has received much attention from physiological botanists and the results of quite extended researches have been published by Sachs, Hofmeister, Detmer and others. The work has been done with very crude apparatus consisting simply of a manometer



THOMAS on ROOT PRESSURE

or a glass tube attached to the stem at its base by means of a rubber tube making with it a water-tight connection. The observations were recorded by marking upon the tube each hour to indicate the rise of water in the tube or by measuring it with a scale in the glass or on a strip of paper or wood behind it. The apparatus required frequent attention and was in no sense self-registering. The other methods used were modifications of these but in all cases frequent attention was required.

The following self-registering apparatus is suggested: The base of the apparatus is about 1 by 3 feet and is supported by legs about 3 inches high. About 10 inches from one end and in the center of the base is erected a standard about 2 feet high and 4 inches in width. On the short end of the base and near the post is fastened a set of strong clock-work (the Seth Thomas "marine works" answer the purpose very well). The clock-work is covered with a box, and the end of a cylinder 6 inches in diameter and 1 foot 10 inches high is fastened to the hour pinion by means of a pin passing through a hole in the end of the pinion and fitting in a slot in the end of the cylinder. The top of the cylinder is held in place by a pin passing through a support from the main pillar, and a hole in the end of the cylinder.

To the large upright pillar is fastened a U-tube, about ½ an inch diameter, one end being nearly as high as the pillar and the other but half the height. The tube is filled with mercury to within about an inch of the top of the short arm. The stem of the plant is cut off near the base and placed in position. An inverted U-tube is fastened to the stem in the usual way by means of a rubber tube tied with wire while the other end of the U-tube is connected to the larger one in the same way. The small U-tube is filled with water through an opening in the top.

The cylinder is made of bright tin and is blackened by revolving it slowly in the flame of a lamp or gas jet.

The indicator consists of a light steel wire with a cork at the end somewhat smaller than the diameter of the tube. This rests on the mercury. It is then at the top of the tube bent at right angles twice and allowed to extend to the bottom of the cylinder, where it is again bent at right angles and the end allowed to rest against the smoked surface of the cylinder. A pin driven in the pillar prevents the wire from turning to one side because of the friction of its end with the cylinder.

As the root absorbs water the pressure upon the column of mercury increases, causing it to rise in the tube, lifting the cork and indicator with it. The indicator then marks a continuous spiral course on the cylinder. As the cylinder revolves once each hour the hourly variation can be studied by observing the distance between the lines.

The supply of water given to the plant is kept constant by means of a flask of water supported by a stand and having an exit tube touching the surface of the water in the dish in which is placed the jar containing the plant.

The apparatus can be made in sizes appropriate for the study of periodicity of root pressure in almost any plant.

An eight day clock should be used and the apparatus need scarcely be touched until the plant is exhausted. The difference between the maximum and minimum variation will grow less as the column of mercury becomes higher but the time of variations will be the same for each day.

The apparatus described may be constructed at a very small expense and used either for laboratory experiments or lecture room demonstration. Many new and interesting problems have arisen during the investigations with this instrument and it is hoped they can be arranged for presentation in the near future.

The record on the cylinder of the apparatus shown in plate XV was made by a tomato plant. The experiment was started at 9 A. M., that being the time represented by the bottom line on the cylinder. The apparatus is represented otherwise as at the beginning of an experiment.

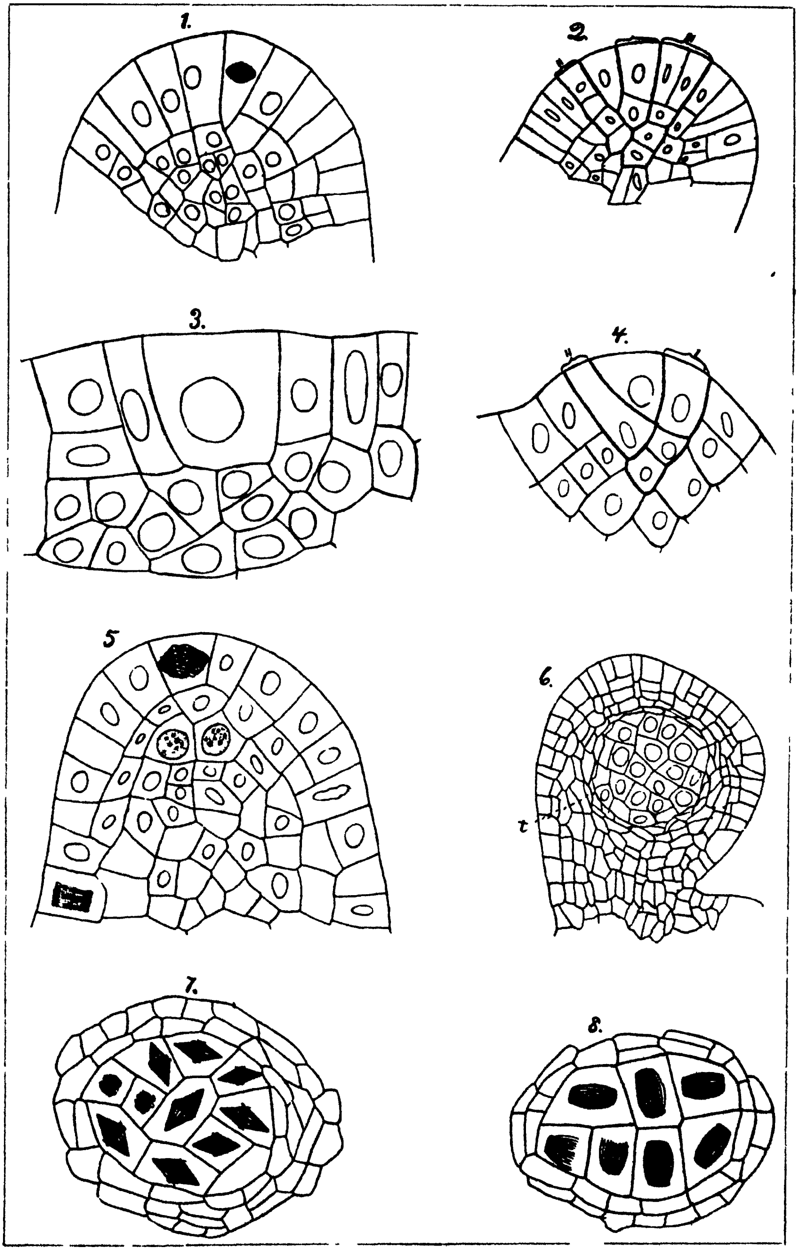
Wabash College, Crawfordsville, Ind.

On the apical growth of the stem and the development of the sporangium of Botrychium Virginianum.

C. L. HOLTZMAN.

(WITH PLATE XVI.)

The origin and affinities of the Filicineæ is one of the most important problems of systematic botany. Among investigations directed to solving this problem not least have been those concerning the origin of the Filices and the relations of the eusporangiate and leptosporangiate groups. It has been advocated by some that the Ophioglosseæ form a natural se-



HOLTZMAN on BOTRYCHIUM.

ries, running from Ophioglossum to Botrychium Virginianum; the latter being closely related to Osmunda and through it, as the connecting link, with the Filices, forming the complete phylogeny of the Filicineæ. With this in view it was thought that if the development and mode of growth of the meristems of Botrychium Virginianum were known, it would possibly show more closely its relations to Osmunda and help to clearer views concerning the position of the eusporangiate ferns.

Dr. Douglas H. Campbell in a comparative study of the roots of Osmunda and Botrychium[1] shows that the roots grow from a clearly defined apical cell in the form of a three-sided pyramid. From the general fact that a fern grows from the same shaped cell in all parts, roots, stem and leaf, it would be expected that a cell of similar form would appear in the stem of this same plant (fig. 1). It is slightly longer than that of the root, but has unmistakably the form of a three-sided pyramid. In the stem figured the nucleus also appears in a state of division. Unless growing very slowly the segments retain their distinctness for a considerable time, often the outline of as many as three or four being easily traceable (fig. 2); while the segments follow the general rules of segmentation and divide by a transverse wall slightly below the center of the cell. The lower part may then divide into several cells by transverse and longitudinal walls; and the upper part first by a longitudinal wall into two, then each of these into two or more, thus after a time confusing the limits of each segment.

Turning now to the sporangium, we find that in the Filices proper the sporangium always arises from a single epidermal cell, which usually, according to Bower[2], projects more or less strongly beyond the surrounding tissue before segmentation begins; then a transverse wall cuts off a lower cell from which the stalk develops, and from the upper one the sporangium proper, or head of the sporangium, arises.

In Botrychium this distinction cannot be made. The sporangium is first noticed as a cell of large size (fig. 3) on the side of the pinnule in section, but not protruding beyond the other cells. The nucleus in the specimen figured, from its comparatively large size and appearance, seemed ready to divide.

---

[1] Notes on the apical growth of Osmunda and Botrychium, BOTANICAL GAZETTE, Feb. 1891.

[2] BOWER: The comparative examination of the meristems of ferns as a phylogenetic study; Annals of Botany, III. 362.

Three oblique walls are formed one after another, thus giving rise to a three sided apical cell. The sporangium now projects slightly (fig. 4), and in the figure probably two segments have been cut off and will be devoted to forming the stalk of the sporangium. While it is true that the sporangium arises from a group of cells, and probably some cells other than those heavily shaded (in fig. 4 those cut off from the original cell) take part in the formation of the sporangium, yet it seems equally probable that the entire sporangium can be referred to the single large cell (fig. 3). If this be true, a closer connection is shown with the leptosporangiate group than has been generally supposed. In Osmunda[3] the sporangium is not always referable to a single cell in its origin, but almost always one is noticeable as the initial cell of the young sporangium, which does not project before segmentation occurs. After the formation of the apical cell the sporangium grows to a considerable size by direct segmentation before any change is apparent. There now becomes prominent the change of the apical cell from a tetrahedral to a cubical form, from a T-division (fig. 5). Three cells, from their general shape, are evidently those which previously formed the single large tetrahedral cell. The sporangium is now probably half grown and the cell from which the archesporium and tapetum develop should make its appearance; but from the great bulk of the sporangium it would escape notice, unless it had a very large nucleus. Not until the primary cell has undergone several divisions are the archesporium cells noticeable (fig. 5). In the sporangium figured there were six of these, all very prominent from the large nuclei in them. These cells divide very rapidly, and cause the body of the sporangium to enlarge, making the distinction of body and stalk noticeable (fig. 6). The stalk is seen to be very short and thick, and the tapetum layer also makes its appearance, consisting of approximately two layers of cells. Even the oblong cell which retained the place of the initial, after the division of the tetrahedral cell, is now no longer distinguishable, each cell dividing as rapidly as possible and the whole sporangium enlarging equally in all parts. It is during the rapid division of the archesporium cells that a very interesting and previously unnoted (?) occurrence was observed, namely the simultaneous division of *all* the archesporium cells in one sporangium. In one (fig. 7) all nuclei were

[3] L. c., p. 362.

in the so-called spindle stage of division, with probably forty to fifty cells in the sporangium. Another stage (fig. 8) showed the division nearly completed, while four or five other sporangia showed their nuclei in various other stages of division.

It appears evident that the origin of the archesporium in Botrychium is more deeply seated in the tissue than it is in the Filices. This, with other characteristics of complexity of structure, according to the generally accepted view, places the Ophioglosseæ in origin as the most recent forms, in opposition to the more primitive Filices. However, it seems probable that the Filices have been a degenerating group, becoming more and more simple according to the nature of their surroundings, and thus necessarily giving rise to new forms; while the Ophioglosseæ retained their complexity and suffered no change, giving them thus the position of the more primitive forms. This we see is supported by Bower[4] with geological evidence.

The material used was fixed in one per cent. chromic acid, stained in aqueous alum-carmine, and after dehydrating, passing through turpentine and imbedding in paraffin, was sectioned on a Minot microtome; then stained on the slide with seventy per cent. alcoholic bismarck-brown to sharply differentiate the cell walls.

Indiana University, Bloomington.

Explanation of Plate XVI.—Fig. 1. Young stem of Botrychium Virginianum showing the apical cell dividing; four segments shown. × 225.—Fig. 2. Pinnule; apical growth; outlines of three segments shaded. × 225.—Fig. 3. Portion of longitudinal section of pinnule showing origin of sporangium (large cell) × 450.—Fig. 4. Sporangium after apical cell is formed, two segments having been cut off. × 325.—Fig. 5. Sporangium in an advanced state of growth, two of the six archesporium cells shown, also the disappearance of the tetrahedral apical cell by a T division. × 325.—Fig. 6. Sporangium nearly full grown; *t*, tapetal layer. × 170.—Figs. 7 and 8. Archesporium cells dividing, tapetal layer of two layers of cells surrounding them. × 325.

[4] Bower: Is the eusporangiate or the leptosporangiate the more primitive type in the ferns? Annals of Botany, vol. V. no. xviii.

Noteworthy systematic and distributional researches.

Recent work in systematic hepaticology.

For a long series of years the systematic study of Hepaticæ seemed to be held in abeyance to the settlement of various morphological problems, and the earlier activity of Nees von Esenbeck, Gottsche, Lindenberg, De Notaris and Sande-Lacoste on the systematic side came to a close midway in the fifties and was revived only by a few descriptive papers by Mitten in the sixties. Starting with the period of Hofmeister and Grönland in the fifties the study of the morphology and development of the group culminated after the preliminary investigations of Kny, Kienitz-Gerloff and Leitgeb in the masterpiece of the latter in 1881.[1] Commencing in the seventies and coming down to the present, some of the best descriptive work among the Hepaticæ has been accomplished largely by representatives of four European countries: Spruce, Pearson and Mitten of England, Lindberg (now deceased) of Finland, Massalongo and De Notaris of Italy and Stephani in Germany. The last decade especially has been prolific in new forms and the recorded number[2] of Hepatics in Synopsis Hepaticarum (1844) has been nearly doubled.

Spruce, whose masterpiece on the Hepaticæ of the Amazon and Andes, is well known, has described recently[3] thirty-four American species mostly from South America, three only being from Mexico. Jack and Stephani have described 18 new species from Peru and the United States of Columbia. Stephani has described two Hepaticæ from North America which were collected by Dr. Julius Röll, besides the Lejeuneas described in the June GAZETTE.

Asiatic Hepaticæ have been described by Lindberg and Arnell,[6] who enumerate all the known species of Asiatic Russia (96) three of which are new; and by Mitten[7] who enumerates

[1] LEITGEB: Untersuchungen über die Lebermoose, 4to, Graz, 1874-81.

[2] 1641 species: Luerssen in his *Handbuch der systematischen Botanik* (1879), curiously estimates the known species at 1300. The number will prove to be not far from 3000.

[3] Hepaticæ Novæ Americanæ tropicæ et aliæ. Bull. de la Soc. Bot. de France, XXXVI, pp. cxxxix—ccvi.

[4] Hepaticæ Wallisianæ. Hedwigia, XXXI, 11–27 (1892).

[5] Bot. Centralb. XLV, 203—4 (1891): Marchantia Oregonensis (Oregon) and Porella Roellii (Washington).

[6] Musci Asiæ Borealis, Kongl. Svenska Vet.-Akad. Handl. XXIII, no. 5, (1889).

[7] On the species of Musci and Hepaticæ recorded from Japan. Trans. Linn. Soc., Botany, III, part 3, (1891).

all the known species of Japan (74) of which thirteen are new; he also describes two Chinese Frullanias.

From Africa numerous contributions have been made to our yet scanty knowledge of the hepatic flora of the Dark Continent largely through German exploring parties. Dr. F. Stephani of Leipzig has described these, his latest papers[8] including 31 new species. Renauld and Cardot[9] publish a list of 190 species of Hepaticæ from Bourbon, Mauritius and Madagascar; a number of new species are mentioned but not described. Pearson[10] describes three new Frullanias from Madagascar.

From Australia a considerable number of species have been described in recent years by Stephani, and Carrington and Pearson, but the greatest number of novelties has been described from New Zealand by Colenso in a series of papers in the Transactions of the New Zealand Institute.

The species of the Sandwich Islands have been brought together by one of our own countrymen, Mr. A. W. Evans of New Haven[11]; 117 species are included in this list, of which five are new. Several of Austin's MS. species are also described. In addition to the species of this list 22 species were described from these islands by Mitten in Flora Vitiensis and *Anthoceros Hawaiensis* by Reichardt in 1877, thus bringing the list up to 140 species which number will be doubtless increased when some modern collecting is undertaken there.

In all the above descriptive papers, the diagnoses are full and are strongly in contrast with many of the two-line descriptions of some cryptogamic writers who have caused untold trouble by their brevity and inaccuracy. Many of the species, especially those in the larger genera, are figured.

Besides the above systematic papers we have an "Arrangement of the Genera of Hepaticae", by Mr. Evans,[12] which is highly creditable and will prove very useful. His estimates for the number of species are cautious and usually low. *Bazzania*, for instance, is credited with 100–125 species while

---

[8] Hepaticæ Africanæ Hedwigia, XXX, 201—217, 265—272 (1891). Earlier papers with same title have been published by Stephani in Engler's Bot. Jahrbücher (1886), Hedwigia (1888), and BOTANICAL GAZETTE (1890).

[9] Revue Bryologique, XVIII, 55—60 (1891)

[10] Frullaniæ Madagascarenses Christiania Vid-Sel. Forhandl. 1890, no. 2 (1891).

[11] A Provisional List of the Hepaticæ of the Sandwich Islands. Trans. Conn Acad VIII, [pp. 1—9] (1892).

[12] Trans. Conn. Acad. VIII [pp. 20] 1892.

Stephani in 1886 gives a list of 169 which even then was not quite complete. The species of *Metzgeria* have doubled since Lindberg wrote his monograph which is quoted as giving eleven species. We note the absence of three of Mitten's genera, *Conoscyphus*, *Mastigopelma* and *Plectocolea*. *Cronisia* Berkeley, which Lindberg changed to *Carringtonia* because he did not believe in anagrams,[13] is also omitted from the series. So also are some of Trevisan's innovations,[14] but possibly the less said of these the better. The widely scattered literature has rendered this work by Mr. Evans specially difficult. [15] A number of generic names will have to be replaced on grounds of priority whenever we have a sufficiently stable system on which to make the shift. One hundred and seventeen genera are included, of which 87 belong to the Jungermaniaceæ. And yet the text-books persist in regarding Marchantia as a representative liverwort!—LUCIEN M. UNDERWOOD.

The psammophilous flora of Denmark.

Prof. Warming presents a sketch of the peculiar vegetation of the dunes and sandy plains in Denmark,[16] arranged according to their occurrence in the following zones: (I) "The psammophilous *Halophyta*" from the sandy strand; (II) "the vegetation characterized especially by the grass *Psamma*" from the dunes along the coast; and (III) "the *Weingærtneria*-vegetation," where this grass prevails, and which has been observed on the sandy banks along the coast or in the interior of the country.

In the first of these "formations" the characteristic is the *Halophyta*, which live here on a loose, sandy and salt-bearing soil, the surface of which is very dry and warm during certain seasons. This vegetation does not form any dense growth, since the consistency of the soil is very variable. The plants belong to two categories; annuals or perennial herbs mostly with widely creeping rhizomes, while trees and shrubs are almost absent. Among the annuals are Cakile, Salsola,

---

[13] Cronisia was based on *Corsinia* which it resembled.

[14] VITTORE TREVISAN: Schema di una nuova classificatione delle epatiche. Mem. R. Ist. Lomb. di Scienze e Lettere, ser. III, IV, (1877).

[15] There is needed a classified bibliography of the Hepaticae and on this we have been working for several years and hope to reach publication of the first part (author catalogue) in a few months

[16] EUG. WARMING: De psammophile Formationer i Danmark. Videnskap. Meddel. Naturh. For. Kjöbenhavn 1891.

species of Atriplex, Senecio viscosus, Salicornia and the variety salina of Matricaria inodora. The perennials are represented by Alsine peploides, Triticum junceum, Festuca rubra, Lathyrus maritimus and the very rare Carex incurva and Petasites spuria. Only a few perennial herbs without creeping rhizomes are recorded from this locality, such as Crambe, Eryngium and Mertensia, all of the species "maritima."

What the author has called the "Psamma-formation," the second zone, includes the vegetation of the dunes which are most typically developed along the coast, where they give the landscape its very singular appearance. They are barren hills exposed to raging storms, and with a vegetation always very poor and monotonous. The plants must be able to resist a living burial in the moving sands. But as a matter of fact the formation of these dunes is actually due to their growth. *Psamma*, *Elymus* and *Triticum* make the foundation, holding the sand together by means of their roots and rhizomes; gradually a hill forms by the continuous deposits of shifting sand. When these plants have succeeded in forming the dune, others soon follow, represented by Weingaertneria, Calluna, or, in some cases, by Hippophaë, and the former growth of Psamma gradually dies out.

It is stated that a single tuft of Psamma has caused the formation of a dune about twenty meters high. This plant is, therefore, better fitted for resisting sand burial than any other. It not only does not hurt it to be covered entirely by the sand; its growth seems really stimulated, the ascending shoots stretching themselves so as to reach the surface and the sunlight.

Elymus arenarius is also a valuable plant for making stable the sand, although it is not nearly so important as Psamma, and does not seem to thrive well before the sand has been fixed. A few other grasses might be mentioned as belonging to this vegetation, namely, Festuca arenaria and some species of Triticum. The spiny, silvery-grayish shrub, Hippophaë rhamnoides, thrives here, and forms almost impenetrable thickets, due especially to its rapid propagation by root-shoots. The roots have been observed to reach a length of about five meters and to go down in the ground to a depth of about thirty cm., developing dense tufts of shoots.

The third zone is characterized by *Weingaertneria* along

with several other plants, which first occupy the soil, prepared by the "Psamma-vegetation," and which, to some extent, contribute to the stability of the sand; for instance, Sedum acre, Taraxacum, Sonchus, Leontodon, Carex arenaria, Thymus, etc. Some of them propagate by root-shoots, while others have widely creeping rhizomes, e. g., *Carex arenaria*, or runners above ground. Weingaertneria differs from these by its cespitose growth which is due to a profuse development of shoots from the axils of the lowest leaves. The young flowers are well protected by the large leaf-sheaths, as is also the case with Psamma.

There are besides these types a few others, which propagate by a multicipital root; such plants are very common in the fixed sand, and several species are enumerated.

These perennial plants have meanwhile prepared the soil for another growth which consists of annuals and biennials; but the immigration of these depends upon two conditions: the sand must have become entirely stable, and its vegetation must not be too dense.

The dune has now gradually changed its character as to soil and vegetation, and it is not seldom that it finally becomes a heath, producing a growth of Calluna and Empetrum.

Among the peculiarities of these sand plants the author enumerates and describes several singular anatomical features. It seems as if the adaptation for regulating the transpiration were the main object, and that end is gained by diminishing the leaf-surface. Several of these plants show, therefore, narrow or very short leaves; the stomata become less numerous and often confined to deep furrows or cavities, a common feature in the Gramineæ. The leaves, or their divisions, are often raised more or less vertically; a covering of hairs or wax is very common, so as to protect the stomata; while in some others a thick cuticle is characteristic. Species of succulent plants are comparatively few in number.—THEO. HOLM.

BRIEFER ARTICLES.

Living fossils.—The great flat slab on which we stood seemed built there to command a view of stoneworts.

In the clear lime water of Fall River, S. D., floated great streamers of Chara, fresh and green, yet fading insensibly, first into a dingy, then into a dead looking, and even into a stony mass, as the eye followed it up stream. It was a streamer of living, growing stoneworts that blended into the slabs of "petrified moss" strewn broadcast in the channel around us, and on one of which we stood.

But the eye could trace this so-called living fossil or petrifaction back still further to the banks overhead, where other stoneworts once floated in waters whose channel was higher than and broader than now. Yet higher still, in an earlier channel, the eye could see great slabs of it, upturned in a railroad cutting.

At our feet, where interposing boulders had reduced the transporting power of the current, a sand bar of broken stems, leaves, and whorls was lying, simply waiting for the "lapidifying juices" to cement it into limestone—a sort of puzzling Chara breccia.

Right here in reach then were all the terms of a botanico-geological stonewort series, a sort of climax, beginning with the perishable, growing plant, and capped by the same built into everlasting rocks and sands.

It only remained for the collector to make his choice, which was done, and the series exposed in a row to dry. The growing stonewort, so fresh and green, became stony, and crumbled at a touch, it was so incrusted with lime salts. So, too, the half-living, half-petrified form fell to pieces, being encrusted just enough to appear stiff and stone-like, yet not enough to last. However, slabs of the "petrified moss" of any desired linear dimensions could be had, and handled with impunity. These ever forming stonewort slabs consisted of a few inches of rigid lithified creek bed, as a stable sort of backing to the stony mat of weeds upon them.

By placing the growing stonewort immediately in glycerine it is easily preserved, and by patience, mixed with a pinch of ingenuity, the whole beautiful and interesting series of living petrifactions can be kept.—ERWIN H. BARBOUR, *University of Nebraska, Lincoln.*

EDITORIAL.

THE COMING MEETING of the American Association for the Advancement of Science is to be one of the most important of recent years so far as botanists are concerned. For that reason, if not for the pleasure of meeting other botanists and reading and hearing interesting papers, there ought to be a large attendance of botanists. The meeting is to be held in the city of Rochester, N. Y., from Aug. 17th to 24th. Reduced rates, one and one-third fare, will be granted on the usual certificate plan on all the railroads of the Central Traffic Association. The University of Rochester opens its buildings to the sections, and the usual receptions and excursions are announced.

Of foremost interest to botanists will be the proposed division of section F into two, and the formation of section G, of botany, leaving F for zoology. This question is to be discussed and settled at this meeting. In case the section is divided, the status of the Botanical Club is to be considered.

It is probable also that the proposed botanical congress in connection with the World's Fair will come before the section for discussion. The Committee which was asked by the World's Fair Auxiliary to take steps to organize such a congress recently prepared a circular letter to the botanists of the country which they vainly tried to have issued as it was prepared. It was only after long delay that it was issued at all, and on its appearance the members of the Committee were nearly as much surprised at its contents as those to whom it is addressed must be. Although the Committee may hope for some information through this inflated circular, they will expect to ascertain more of the temper of the botanists toward this scheme at the coming A. A. A. S. meeting.

***

ONE OF OUR good friends writes: "I wish that the less ponderous and profound botanists were not so 'offish' in sending contributions to the GAZETTE. I like to have the work of the editors more appreciated and not sunk out of sight by over-weighty articles. . . . The *Bulletin* makes me swear . . . . ; and the GAZETTE, alas, puts me to sleep!" We almost envy the *Bulletin* this distinction; anything but being prosy! Yet it is with a clear conscience that the editors print this accusation against the "less ponderous and profound botanists;" it does not lie against the editors.

We have so often urged the "small fry" (as another friend calls this class in which we all claim to rank) to send notes and items regarding their work, that we are blameless. Not only has the invitation been pressed, but the most ample provision has been made for these shorter articles.

When the departments of the GAZETTE were differentiated, "Briefer Articles" was established to receive communications of less than two pages. Later "Open Letters" was provided for those who chose to put items of interest, discussion or criticism into this form. And for the briefest, "Notes and News" is always waiting.

The GAZETTE does not print all MSS. which are sent to it. But we can truthfully say that no communication was ever rejected because it was too short or would interest only amateurs. On the contrary we welcome the notes by amateurs for amateurs, and lament the decrease of "briefer articles."

CURRENT LITERATURE.

The Myxomycetes of eastern Iowa.

The leading paper of the latest number of the *Bulletin* of the laboratories of natural history of the State University of Iowa [1] is a descriptive catalogue of the myxomycetes of eastern Iowa, by Prof. T. H. McBride. Sixty-six species are described, and most of them are beautifully figured on the ten plates drawn by Miss Mary McBride to accompany the monograph. Incomplete as it may be for its own locality and for others further removed, there are many botanists who have desired to know something of the group who will welcome this work, and will thank its author for the care and labor he has expended in its preparation. We trust that it is only preliminary to a fuller and more elaborate account of the species of the upper Mississippi valley. We suggest as an improvement for the next edition, that the author carry his "keys" further, to include the species of the larger genera, such as Trichia and Physarum. It is a help to the beginner, out of all proportion to the labor it costs the author, to have some clue to the species, after he has been led by keys to the genus.

The Missouri Botanical Garden.

The third annual report of this institution was issued about the first of June. The report of the director, Dr. William Trelease, is most interesting to those who are watching eagerly the progress of the garden, for it summarizes the improvements of the past year, certainly one of the most active since its organization. Besides the necessary work of maintenance, many repairs and improvements have been made. They have included excavating and remaking in a substantial manner many of the walks; extensive draining; resetting of edging for

---

1 Vol. II, no. 2, pp. 99—162, pl. 10.—June 1892.

the beds; replacing all the sets of steps about the parterre; rebuilding from the foundation the west wing of the greenhouse and repairing it throughout; replacing unsightly and dilapidated wooden fences with open wire or iron ones; beginning to put the fruticetum into order by removing some of the old and useless trees, subsoiling about 5 acres, spading about one acre of it from two to two and a half feet deep, and planting a small orchard and a considerable number of shrubs. In addition to the introduction of many plants brought from the West Indies by Mr. Hitchcock, a very successful attempt has been made to introduce hardy native species into the grounds. About 1500 species were planted under the direction of Mr. F. H. Horsford; a bog and artificial pond and many small beds having been prepared in the arboretum. The trees are being labeled with white-bronze plates bearing the name in raised letters, while white celluloid labels have been found best for the herbs. The Engelmann and Bernhardi herbaria have been mounted and arranged. They contain about 155,000 specimens. Dr. Trelease has also donated his private collection, chiefly of fungi, containing about 11,000 specimens, and his library of 500 books and 3000 pamphlets. Mr. Shaw's city residence has also been taken down and rebuilt in the garden, in accordance with the directions in his will. It is now occupied by the herbarium and library, for which it at present forms commodious quarters. In rebuilding, it was made fireproof. The library now contains about 6,000 volumes, and receives a large number of exchanges.

This is truly a record of remarkable activity, and augurs well for the future. All that is done, is being done with reference to perpetuity and permanent value, a policy that cannot be too warmly commended.

Though so much foundation work is being done, immediate results in scientific lines are not lacking. The report contains a thoroughgoing revision by Dr. Trelease of the 21 American species of Rumex, illustrated by 21 full page plates; a complete recapitulation by Dr. C. V. Riley of the observations on the Yucca-moth and Yucca-pollination, together with descriptions of the species of Pronuba and its allies, illustrated with 10 plates: notes and observations on the species of Yucca, hy Dr. Trelease, illustrated by 23 plates; a description by Dr. Trelease of *Agave Engelmanni*, n. sp., with plate; and finally a short paper by Thos. A. Williams on the fruit of *Parmelia molliuscula* Ach., a lichen whose apothecia, hitherto unkown, were discovered by Mr. Williams on a specimen in the Engelmann herbarium.

In such a foundation for research, and in these early results, American botanists may feel a just pride!

The principles of agriculture.[1]

Under this title Mr. Winslow seeks to set forth the elementary principles of chemistry, physics, geology and biology so far as they affect domesticated plants and animals. We have nothing to say of the parts of the book other than the botanical, further than this, that they seem to be of about the same quality. In the physical chapter, for instance, we notice a tranverse section of a woody stem used to illustrate the "porosity of matter"! The chapter on plants wholly ignores the existence of any but the flowering ones. The consideration of these almost begins with the hoary yarn about the germination of seeds from the hand of an Egyptian mummy 3,000 years old. And what follows is not materially better. The embryo of the bean is said to be located at the "eye"; "seeds *are supposed* to contain a supply of nourishment sufficient to support the young plant until the ascending stem can reach the open air"; "a *shoot* called the radicle extends downward"; "the radicle is the origin of the roots of plants"; these are some sentences from the paragraphs on seeds. Mr. Winslow gravely argues that the directive force for the stems and roots cannot be light "as it has been found that the same directions are followed when a seed is sprouted in darkness." He therefore concludes that plants are "endowed with a kind of instinct similar to the instincts of animals." Heliotropic and nyctitropic movements "we cannot account for with certainty, in a scientific way."

The rise of the "sap" is due to "capillary attraction." The "material of the roots has a very strong attraction for water" so that the water is drawn up with considerable force, so much in fact that that "this force is sufficient to assist in the extension of buds and leaves in their growth. It is supposed to explain also the tall slender growth of crops in a wet season", in which case the author suggests that the plants are forced "out of their normal dimensions"!

Oh for a writer on elementary science who has some knowledge! However it may be in religious experience, it has been abundantly demonstrated that in science, out of the mouths of babes and sucklings praise has *not* been ordained.

Minor Notices.

MR. THEO. HOLM has prepared the "Third list of additions to the flora of Washington, D. C.", which has been published by the Biological Society of Washington.[2] About 80 species and varieties have been

[1] WINSLOW, I. O.—The principles of agriculture for common schools. Large 12mo. pp. 152. Chicago: The American Book Co. 1891.

[2] Proc. Biol. Soc. Wash., Vol. II, pp. 105—132.

added since the last supplement by Knowlton in 1886. Numerous new localities are also given.

IN 1868 Dr. G. L. Goodale published a list of the phanerogams of Maine, which has generally been known as the "Portland Catalogue." A second edition of that list has now been prepared by Mr. M. L. Fernald, [1] of Cambridge, Mass. The list incorporates the discoveries since 1868 and by marks gives some indication of the distribution of plants in the state. Mr. Fernald proposes a complete annotated catalogue later, and asks assistance particularly in the collection of cryptogams.

IN A RECENT paper in the *Proceedings* of the California Academy of Sciences [2] Dr. Douglas H. Campbell gives a detailed account of the structure and development of the prothallium and embryo of Marsilia vestita.

A SECOND EDITION of Webber's "Appendix to the catalogue of the flora of Nebraska" has been issued by Dr. Charles E. Bessey of the University of Nebraska.[3] In addition to the correction of a few minor errors and the rearrangement of the index there is a supplementary list of recently reported species by Dr. Bessey.

TWO PAPERS on the Hepaticæ have recently been distributed by their author, Mr. A. W. Evans.[4] His "Arrangement of the genera of Hepaticæ" is an attempt to bring together the genera of these plants which are best entitled to recognition into natural groups, with a citation of the place of original publication and the chief synonymy. It will doubtless be of use to students of this group. The other paper is "A provisional list of the Hepaticæ of the Hawaiian Islands" and is based upon collections made by D. D. Baldwin in 1875-6 as determined by Austin. Ten new species are described and figured, of which five are credited to "Austin MS."

THE FOREST TREES of Indiana are enumerated by Prof. Stanley Coulter in a pamphlet reprinted from the Transactions of the Indiana Horticultural Society for 1891. One hundred and eight species are found in the state. Concerning these Mr. Coulter has gathered much valuable information from his own observation, from MSS. material placed at his disposal, and from previous publications on the plants of the state, particularly as regards their distribution and economic importance.

---

1 Proc. Portland Soc. Nat. Hist. 1892.

2 Second series, vol. III, pp. 183—205, plate iii. April 19, 1892.

3 Contributions from the Botanical Department of the University of Nebraska, new series, III. June 14. 1892.

4 From Proc. Conn. Acad. Sci., vol. VIII.

OPEN LETTERS.

Pink and yellow pond-lilies.

Pink pond-lilies are very commonly sold in Providence at the card store of Mr. E. C. Davis. Correspondents can always purchase them here in good shape. What I write to record, however, is the presence now, in the same shop, of a bunch of these lilies which are of an exquisite shade of pale *yellow*. I never saw anything like them before. Both kinds come from Cape Cod. We used to have, according to George Thurber, a locality for the pink ones near Providence; it has long since vanished.

Mr. J. F. Collins has found *Lotus corniculatus* here.—W. W. BAILEY, *Providence, R I.*

NOTES AND NEWS.

Two forms of registering apparatus for studying transpiration are described by Messrs. Taylor and Frost.

THE MAY number of the *Student* opens with a sprightly sketch of Julius von Sachs by Mr. Hubert M. Skinner.

THE TWO PAPERS of botanical interest in the June number of the *Forstlich-naturwissenchaftliche Zeitschrift* are "the quality and structure of fir wood," by Dr. R. Hartig and "the influence of elevation on the temperature of the soil," by Dr. E. Ebermayer.

A LUCID SUMMARY of our present knowledge of the nature and origin of fecundation both in the plant and animal world is to be found in the February and April numbers of the *American Naturalist.* It is the text (and illustrations) of a lecture delivered by Mr. H. J. Webber of the Shaw School of Botany before the Alumni Association of St. Louis Medical College.

HERR AMM, under the direction of Prof. Detmer, has conducted a series of experiments on the intramolecular respiration of plants, by which he has demonstrated the direct dependence of this sort of respiration on temperature, and on the stage of growth of the plants. It increases up to the optimum temperature for normal respiration, and also with the age of the seedlings, up to nine days.--See *Ber. d. deutsch. bot. Gesells.*, vol. x ,heft 4.

A PRIZE of a thousand marks is offered by the Experiment Station of Middle Java for the best investigation on the causes and prevention of the disease of Sorghum which is characterized by the reddening of the fibrovascular bundles. The limit of time for the investigation will be announced later. Manuscripts have to be written in German, and the usual precautions for withholding the name of the writer from the committee of award are to be observed.

THE WISCONSIN ACADEMY of Sciences, Arts and Letters held its field meeting for 1892 at Ripon, Wis., on June 2—4. The plans of the committee regarding out-door work were completely blocked by the steady

rains. A preliminary paper on the flora of Dane county, Wis., was presented by Messrs. R. H. True and L. S. Cheney of the University of Wisconsin, and Prof. C. R. Barnes delivered the public address in the Ripon College Chapel on "Asa Gray."

DR. J. C. ARTHUR publishes in the May number of *Agricultural Science*, a paper read before the Society for the Promotion of Agricultural Science at its Washington meeting, on the physiological basis for the comparison of potato prudction. He concludes that to make fair comparisons the seed material must be of the same weight, roughness and number of pieces; and that if the tuber is divided, only the same regions of the same weight tubers are comparable.

W. C. SHANNON, Asst. Surg. U. S. A., as member of the Central Division of the Intercontinental Railway Commission has collected specimens of the natural history of the various regions of Guatemala embraced in the surveys of the Commission. Capt. M. M. Macomb, U. S. A., Engineer in charge, has turned over the entire botanical material to Mr. J. Donnell Smith for elaboration, and for distribution to the chief herbaria. These plants will accordingly form part of the extensive series entitled, *Ex Plantis Guatemalensibus quas edidit John Donnell Smith.*

AT THE LAST commencement of the University of Wisconsin two of the theses presented were of botanical interest. Mr. A. M. TenEyck read an honor thesis on the "Regermination of seeds." Mr. Ten Eyck has carried out a long series of experiments to determine the number of times seeds of various garden and field plants could be made air-dry without destroying their vitality. Some, notably the cereals, will stand an astonishing amount of this hard treatment, growing after as many as 12 desiccations.[1] For the degree of M. S., Mr. Rodney H. True presented a thesis "On certain species of the so-called orthocarpous Dicrana." This will be published as part of a revision of the Dicrana in preparation by Messrs. Barnes and True.

THE PROGRAM of the international botanical congress, to be held at Genoa between the 4th and 11th of September, 1892, has been issued. Sunday, Sept. 4, is devoted to a reception of the foreign botanists. Various excursions are planned during the week. All the sittings of the congress will be public. The official language will be Italian, but it will be free to everybody when speaking or in discussions to use whatever language he may be most familiar with. It was not considered advisable to fix any special subjects for discussion, but it is announced that the reform of botanical nomenclature will be treated in accordance with O. Kuntze's recent book! After the congress, the committee will print a brief account of the meetings and will publish also the original memoirs.

PAUL SCHOTTLÆNDER has found that the same differential standing of the sexual cells of plants is possible as Auerbach has demonstrated in the sexual elements of anamals. Sections of the prothallium of *Gym-*

---

1 In the May number of the *Revue gen. de Botanique* M. Gaston Bonnier records some similar but much less comprehensive experiments on the revival of seedlings after complete desiccation.

nogramme chrysophylla showing both antheridia and archegonia were double stained by Rosen's method, which will be described in the next part of Cohn's Beiträge zur Biologie der Pflanzen. Under this treatment the bodies of the spermatozoa are colored intense blue, while the plasma and nucleus of the egg cell are red. We see possibilities of material aid in determining the homologies of the embryo sac structures by this process. Schottländer's paper is only preliminary to fuller researches and publication.

THE FIRST REPORT of the director, Prof. F. H. Snow, of the temporary station of the University of Kansas, which was established "to promote and conduct experiments for the destruction of chinch-bugs by contagion or infection," has recently been issued, and forms an octavo volume of 230 pages, with plates and map. There are three diseases of chinch-bugs studied by the station: the white-fungus disease caused by Sporotrichum globuliferum, the gray-fungus disease caused by Empusa aphidis, and the bacterial disease caused by Micrococcus insectorum. The fungous diseases thrive in damp weather and the bacterial disease in dry weather. In 1891 three-fourth of the attempts to artificially carry infection were successful. Reports were received from 1400 farmers.

THE INTENSITY of the breathing process in plants which thrive in shade compared with those which require full exposure to sunlight has been investigated by Adolf Mayer (*Landw. Vers. Stat.*, XL, 203). For one class he used house plants, such as Tradescantia zebrina and Saxifraga sarmentosa, and for the other class field plants, such as rye. The leaves of the house plants took up much less oxygen in the same time, than those of the field plants as compared either with their living volume or dry weight. From this he concludes that plants which thrive in the shade, while unable to assimilate as much nutriment as others for want of sufficient light, yet are able to provide the same excess by reason of the lower intensity of the oxidation processes.

WILHELM RAATZ describes and figures, in the Berichte der deutschen botanischen Gesellschaft x. 183, the tyloses which he has discovered in the tracheides of species of conifers. In the same journal (vol. vii) Conwentz had declared the existence of such structures in the wood of the trees producing amber. But Raatz holds that this rests on a false interpretation of the structures seen and that the true tyloses are now for the first time figured and described. They are quite similar to the same structures in the angiosperms but are much less common, apparently arising only in the wood near a wound; as if the energetic radial division of the cambium to cover a wound spread to the neighboring tissues.

THE HOPKINS SEASIDE LABORATORY, a department of the Leland Stanford University, has been located at Pacific Grove, California, and will hold its first session of five weeks, commencing June 27th, during the present summer. Pacific Grove is a sea-side resort on the southern shore of Monterey Bay, two miles west of Monterey, and the seat of the Pacific Coast Chautauqua Assembly. Through the generosity of the Pacific Improvement Company, a piece of land has been furnished, and a sum donated sufficient to erect a plain frame building; and by

the liberality of Mr. Timothy Hopkins provision is made for the equipment of the building, and for the future continuation and extension of the enterprise. The library and apparatus of the University laboratories will be used.

An elementary course in marine botany will be given by an assistant selected by Dr. Campbell, as the engagements of the latter will prevent his being present during this season.

IN THE *Annals of Botany* for April Mr. W. A. Setchell presents the results of his examination of the species of the genus *Doassansia.* He recognizes 12 species, of which two, *D. obscura* and *D. deformans,* are new, occurring on the stems of Sagittaria variabilis in Massachusetts and Connecticut. Two new genera, *Burrillia pustulata,* in honor of Dr. T. J. Burrill, and *Cornuella lemnae,* in honor of Prof. M. Cornu, are also described, the former from Illinois and Wisconsin and the latter from Massachusetts. In the same number, Dr. D. H. Campbell discusses the prothallium and embryo of *Osmunda* and suggests the bearing of the observed facts on the phylogeny of the ferns. Bacteriologists also will be specially interested in the article of Mr. H. M. Ward on the characters or marks employed in the classification of the Schizomycetes, at the conclusion of which he suggests the questions which should be answered by bacteriologists before they publish a species as new. These relate to habitat, nutrient medium, gaseous environment, temperature, morphology and life history, and special behavior.

THE UNIVERSITY of MINNESOTA has begun the publication of a *Quarterly Bulletin* under the editorial management of Prof. Conway MacMillan, and the direction of a board of editors appointed from the various faculties of the University. The following items of botanical interest are taken from the first number:

Work upon the botanical survey of the state is being pushed with vigor. Three collectors last season brought in more than 20,000 plants, covering in their exploration pretty thoroughly the valley of the Minnesota. This season four collectors are in the field. It is the intention to gather largely for exchange, with a view to strengthening the herbarium in plants of the southern hemisphere. The collectors will give special attention to the fungi, lichens and algæ.

Dr. Albert Schneider has in press in the Minnesota Academy a paper criticising Jumelle's researches on the influence of anesthetics on transpiration. (See this journal XVI, p. —.) His experiments lead him to the conclusion that ether *retards* transpiration by retarding assimilation, under all conditions. Jumelle's results were faulty in the use of parts only of plants and in confounding evaporation with transpiration. The increased loss of water vapor from anesthetized vegetable tissue is due to the alteration of the primordial utricle by the ether, allowing evaporation to take place.

BOTANICAL GAZETTE.

AUGUST, 1892.

On the relation of certain fall to spring blossoming plants. II.

AUG. F. FOERSTE.

[PREFATORY REMARKS —I regard the present paper as a continuation of that published in this journal, vol XVII, p. 1 It is of wider application than the citations of European plants alone would seem to indicate. Its purpose is to set forth the general relations between certain fall and certain spring flowering plants, and to explain how some spring plants took up the habit of flowering in the fall. The paper is intended simply as a theoretical discussion. But such a discussion must rest upon facts. I do not know the plants of the southern United States well enough to cite these in illustration of my points On the other hand the data on the flowering seasons of the plants of Italy and France are extremely rich The plants of these countries have been well observed for several centuries, and the frequency even of accidental times of flowering has been quite well determined by this time The plants of these countries, therefore, furnished the desired data, data which I could not find at home Moreover, I have had an opportunity to see many of the plants in question. I have a great quantity of notes bearing on this subject in addition to those offered in the paper, but it would have unnecessarily extended it to introduce these.

For the present, my studies of this subject, as regards European plants, may be considered finished. It is my intention, however, to study the similar cases which I expect to find in the southern United States When it comes to a discussion of this material I will find it very convenient to have already placed on record the much better array of facts which are offered by these studies of the plants of France and Italy, data for which are much more complete. I think that while it must have struck observers before that certain fall flowering species were nothing but earlier flowering spring species, the presentation of a body of facts, like the present one, will draw more especial attention to studies of this kind; and will lead to an explanation of the fall flowering habits of other plants, where the real reason has formerly not been suspected. Perhaps one of the most important results will be the discrimination between the flowering seasons of various plants according to their *former* habits, a process which cannot be without value when it comes to a scientific study of phænology, plant climatology, etc.

I am well aware that modern botanical study is largely histological and morphological; yet I believe that there are still results worth obtaining in some of the older fields of botanical research, which, although not of the highest scientific rank, are yet worth cultivating, and constitute a part of botany in its largest sense.—*From a letter to the Editors.*]

I. If a comparative study of the flowering seasons of the plants of France, and those of Italy, Corsica, and Sardinia be made, the first feature likely to force attention is the greater proportion in the more southern regions of those plants which

ordinarily flowering in the spring, also more or less habitually blossom a second time in the fall. This fall flowering of spring plants occurs with such regularity in the case of certain species that it is not uncommon to find the fact noted in the manuals of botany. The following list includes the chief species among those noted from Italy and the islands, and will serve to give a good idea of the wide range of plants among which this habit has been observed:

Fumaria parviflora, Morisia hypogæa, Cardamine hirsuta, Sinapis amplexicaulis, Iberis garrexiana, Reseda Phyteuma, Viola odorata, V. tricolor, Polygala vulgaris, P. flavescens, Silene paradoxa *sometimes*, Malachium aquaticum *sometimes*, Malva rotundifolia, M. borealis, Erodium maritimum, E cicutarium, E. romanum, Potentilla Tormentilla, Lythrum acutangulatum *sometimes*, Trichera arvensis *sometimes*, Bellis perennis *rarely*, B. annua, Evax pygmaea, Centaurea aspera, Taraxacum officinale, Crepis bursifolia, Specularia speculum *often*, Erythraea maritima *sometimes*, Lycium europeum, L. afrum, Teucrium fruticans, Ajuga Chamaepitys, Salvia Verbenaca, S. multifida, Scutellaria Columnae *sometimes*, Lamnium album, Micromeria approximata, Globularia Alypum *in warmer places*, G vulgaris *sometimes*, G. incanescens *sometimes*, Daphne collina *sometimes*, Daphne Cneorum *in certain Alpine regions*, Passerina hirsuta, and several species of Urtica.

A corresponding list from France would be considerably smaller. If species growing only in southern France, such as Ononis minutissima and Gentiana pyrenaica, were excluded, it would scarcely number a fourth of that of Italy. A corresponding list from Sweden would include but few species indeed. The explanation for these facts is very evident. In the more southern countries spring begins much earlier, and the warmer rays of the autumn sun linger much later than in the more northern ones. In Italy, therefore, many plants manage to flower a second time in the fall, owing to different reasons.

These may be that the seed produced by spring flowers had time to germinate and develop into a plant of sufficient size to produce flowers already in the same fall; or, the parching summer sun having produced an enforced rest in the case of certain species, the fall rains again called forth vegetation, and with it flowers; or, the same vegetative stalk, after having once flowered and produced fruit, began to blossom again, usually in an indifferent way, in the fall. In the more northern countries there is not enough time between spring and fall to permit many spring plants to develop this habit of flowering again in the fall.

Considering how long this habit of fall flowering has been noted in the case of certain species blooming normally in the spring, it is surprising that no studies should have been made

to ascertain to what extent these fall flowers succeed in ripening seed capable of germination in the following spring. Nor is the writer able to furnish this desirable information. It is to be presumed, however, until more definite data are at hand, that in a considerable number of cases these fall flowers do not produce seed capable of germination.

II. The fact that spring plants begin to blossom at a much earlier season in southern countries than in northern ones is of course known. But to those who are accustomed to consider the first of January as an ever-ready division between fall and spring, it may be a second feature of interest to notice that spring for quite a number of Italian plants may be said to begin at a yet earlier date. Thus species of Helleborus, Ophrys, and Narcissus begin to flower in Italy even in December. Other species blossom from fall to spring. Among the latter are Iberis semperflorens, October to April; Anagris fœtida, December to March; species of Calendula, November to March; Periploca lævigata, November to March; Lithospermum rosmarinifolium, December to April; Iris alata, November to March; and Arisarum vulgare, November to March in the more southern localities.

The following species blossom from fall to the middle of winter, but their relation to ordinary spring flowering species is unmistakable: Ranunculus bullatus, October to December; Helleborus niger, November to January; Bellis sylvestris, September to December; Thrincia tuberosa, October to December; Campanula isophylla, September to December, and Arbutus Unedo, October to January. Certain species are mentioned as flowering in the fall and again in spring: Koniga halinifolia, October, November, and again in April and May; Linum maritimum, November, December, and again in March. The close relationship of this habit to that of spring plant's flowering a second time in the fall will be at once noted.

Three other species, apparently belonging to the same list, had perhaps better be described as fall flowering plants blossoming occasionally again in the spring: Bellis sylvestris, Mandragora vernalis and Colchicum autumnale.

A certain number of corresponding species are found also in France, especially in its southern portions, although less frequently than in Italy. From the middle of winter to spring: Helleborus niger, January to April; Petasites fra-

grans, December to March; two species of Erica commence flowering in January. From fall to spring: Arbutus Unedo, October to February; Passerina hirsuta, October to April. North of France flowering rarely begins sufficiently *early* to merit consideration in this connection.

The various short lists just mentioned indicate very well a sort of tendency which certain spring flowering plants have of flowering more and more early, so that in the case of certain species the flowering season begins early in the winter, and with others, already in the fall. The fall flowering species of this series differ widely from the cases of accidental, or more or less regular and repeated reappearance of flowers in the fall which was noted in the case of many plants at the beginning of this paper.

1. Fall flowering with the second series is *not* a case of the reappearance of flowers for the second time during the same year. 2. *All* of the species of this series ripen their fruit, although quite frequently not before the following spring. 3. Fall-flowering with them may be regarded as a matter of more or less gradual development, as the tendency to blossom early, carried almost to excess, and not, as in the case of the plants first discussed, a sort of sport of nature, which has assumed a more or less fixed habit with certain species.

III. After examining the various notes just presented, showing how some plants have come to flower in the fall, by methods totally diverse, the presence of a considerable number of species flowering only in the fall, and yet finding their immediate relatives with spring plants, can no longer be surprising. As might be expected, these species are more common in Italy and in southern France, than farther north. The following is a list of the species flowering ordinarily only in the fall in Italy, Sardinia and Corsica; the species printed in Italics occur also in southern France:

Ranunculus bullatus, *Ceratonia Siliqua*, Glinus lotoides, *Hedera Helix*, *Taraxacum gymnanthum*, *Erica multiflora*, *Cyclamen Europæum*, *C. Neapolitanum*, C. Poli, Daphne Gnidium, Triglochin laxiflorum, Posidonia Caulini, species of Crocus, Narcissus serotinus, *Sternbergia lutea*, St. colchiciflora, Leucojum autumnale, Scilla intermedia, *Colchicum autumnale*, C. Neapolitanum, *C. alpinum*, Arum pictum, Biarum tenuifolium, and Botryanthus parviflorus.

In addition to the above species in Italics, the following species entering from Spain, are also found in southern France, with the same habit of flowering in the fall: Viola arborescens, Androsace pyrenaica, Merendera Bulbocodium, and Crocus nudiflorus.

Of the various fall flowering species just cited only four have a geographical distribution extending further north than southern France. Cyclamen Europæum and C. Neapolitanum reach central France. Hedera Helix, and Colchicum autumnale extend considerably north of the northern boundary of France. The centre of geographical distribution for almost all these species lies therefore south of France, and in a measure the habit of fall flowering, as exemplified by these species flowering only in the fall, may be considered as a habit which originated in countries further south, which by a spread of the geographical range of the species was carried often as far north as southern France, but rarely surpassed this limit. There is not a single species in France flowering only in the fall, which does not in its geographical distribution reach Italy or Spain. This is an important observation, not only as indicating the respective places of origin of this habit (for the species here discussed) as just suggested, but also as indicating the probable method in which this habit originated, as will be seen presently.

IV. As has already been indicated, there are three methods in which species, flowering only in the fall, may have gained this habit: 1. They may simply be cases of more and more retarded development of flowers, ordinarily blossoming in the late summer. 2. They may be spring flowering plants, which, by a sort of freak of nature, managed to flower a second time in the fall, and then made this more or less of a habit. 3. Fall flowering may also be a result acquired by the continued application of the tendency of certain spring plants to blossom very early, some of them having succeeded in blossoming already in February, others in December, and the species in question even in November and October. Which of these three tendencies or methods is the cause of the fall flowering of the species last mentioned?

To a certain extent this question can be answered. In the preparation of the various lists quite a number of species were encountered which had developed the habit of fall flowering, by a simple retardation of the period of development of their blossoms. These species were usually detected by the fact that all their relatives were summer flowering species; there were no close spring flowering relatives, nor did the plants, in their habits or in any part of their structure, indicate that they had ever passed by the stage of a spring plant.

The names of these species have been purposely omitted in this paper, and yet it is possible that certain of the species mentioned under the third series (III) may have had such an origin. This may, for instance, be true of Viola arborescens, Ceratonia Siliqua, Glinus lotoides, Erica multiflora, Androsace pyrenaica, Daphne Gnidium, and Triglochin laxiflorum.

Ceratonia Siliqua has close inflorescences, in the axils of the leaves of the same year's growth, which blossom in September and October. This is remarkably retarded development for the flowers, considering that the subtending leaves are already formed in spring. On the other hand, these inflorescences may be branched, or even be developed together with a few leaves on short lateral branches; and no signs of a former existence as a spring flowering tree are shown by any remnants of organs protecting these inflorescences from the cold. Species of Erica often commence flowering very early in southern countries. Perhaps E. multiflora is only an accentuated case of this very early flowering. Androsace pyrenaica is only a later flowering form of the summer blossoming species. Daphne Gnidium is certainly only a retarded case of late summer flowering. Its name has been retained in the list simply to introduce the following remarks: Most species of Daphne have the flowers or inflorescences developed during the same season as the subtending leaves. In the case of a few species, however, the flowers develop from buds in the previous year's axils, the subtending leaves remaining persistent in Daphne Laureola, D. Philippi, and being deciduous in D. Mezereum, D. Blagayana, D. sericea, and, possibly, D. collina. The flowers of the latter species have, exteriorly, a woolly covering. Now, it is evident that, in case any of the species of Daphne were ever to take up the habit of flowering in the fall, it would be apt to be one of the early spring flowering series just mentioned, which have their buds already partially developed in the axils of last year's leaves, and which have already taken up the habit of flowering as early as possible, rather than the later spring flowering species which develop first from this year's axils.

The case of Daphne Cneorum, a spring flowering species which sometimes blossoms again in September, is instructive in this connection, in that it has not been possible to learn that the fall blossoms were accustomed to ripen their seeds. Triglo-

chin laxiflorum occasionally also flowers in spring. Tr. Barrelieri flowers in May. Tr. maritimum blossoms in June and July. There are no data at hand to discuss the usual fall flowering of the species first mentioned.

The remaining species of list III are considered as fall flowering plants which formerly blossomed in the spring. This remainder may be conveniently divided into two divisions, based upon their presumed former habits, species in which the flowers were probably never developed a long time before blossoming, and which, therefore, furnished no protecting organs for the flower buds against winter weather; and species which formerly developed their flower buds during the fall and kept them protected against the cold of winter in scaly and often subterranean buds before the final development and blossoming in spring. To the first division belong Ranunculus bullatus, Taraxacum gymnanthum and species of Cyclamen.

Ranunculus bullatus flowers in October, has scapes bearing single terminal blossoms, surrounded at the base by root leaves. It has altogether the aspect of a spring plant. Taraxacum gymnanthum flowers in September, much after the fashion of any dandelion which begins to blossom freely again in the fall, only this species does not, unless rarely, make its appearance in the spring. This species forms the best case of a plant formerly flowering in the spring, which *possibly* took up the habit of fall flowering as the result of the frequent continuation of the freak of nature in accordance with which spring plants sometimes flower a second time in the fall.

Among European species of Cyclamen the following blossom in the spring: C. repandum, March to May; C. latifolium, January to April; C. Coum, January to March. The following flower in the fall: Cyclamen Europæum, August to September; C. Africanum, November to December; C. Cilicium, September to October; C. Neapolitanum, September to November; C. Poli, September to November; C. Græcum, October to November. C. Europæum flowers probably most of the summer in some places further south. The other species all flower so decidedly in the fall or in the spring, and the related genera are so commonly spring flowers, that the origin of the fall flowering species of Cyclamen from former spring flowering ones seems very probable.

Fall flowering species, in which the plants show means of

protection of the flowers against the winter cold, are the following: Hedera Helix, Posidonia Caulini, Crocus spp., Narcissus serotinus, Sternbergia lutea, St. colchiciflora, Leucojum autumnale, Scilla intermedia, species of Colchicum, Merendera Bulbocodium, Arum pictum, Biarum tenuifolium and Botryanthus parviflorus. Of these species only Hedera Helix has aerial scaly buds. This species and Hamamelis Virginiana were discussed in a former paper. It was there also suggested that the scaly bud which in Hedera for some time encloses the flowering umbel is probably the remnant of a larger scaly bud which protected this umbel all winter, at a time when this plant flowered still in the spring. In Posidonia Caulini, the flower buds are protected by a sort of coarse bulb formed by the bases of the leaves. It flowers in October and fruits in February and March. B. Ardoino in his Flora des Alpes Maritimes, mentions a variety, P. major, as flowering in May and fruiting in August. The habit of P. Caulini to fruit in the spring is very suggestive of a former spring flowering history for this plant, especially when the habits of the variety major be considered. The coarse bulbs of this plant are probably most of the time covered by water.

The flower buds of the remainder of these species were formerly protected during winter in scaly subterranean bulbs, or in the scaly buds crowning subterranean fleshy corms. In the following remarks it has been thought best to draw into the discussion related species of Europe and vicinity.

Crocus. In a review of the genus by G. Maw, 43 species are described as flowering in the spring, often very early, and 26 species as blossoming in the fall; 10 of the latter have the leaves dormant during the flowering season. Whether the flowers appear in the spring or the fall, with or before the leaves, it is a general rule that the leaves attain their full development first as the fruit begins to ripen. Now as the fall flowering species develop their fruit first in the following spring it follows that the leaves of *all* the fall flowering species do not reach their full development until the following spring, the period of fruiting.

Narcissus. In a review of the genus by J. G. Baker only three fall flowering species are mentioned: N. serotinus, N. elegans, N. viridiflorus. Only in the first mentioned species are the leaves not contemporaneous with the flowers, its leaves usually not appearing until the scape dies down. All the

other species, here not mentioned, flower in spring, the latest until May. The relation of the fall to the spring flowering species is evident.

Sternbergia. Of the European species St. lutea and St. sicula blossom in the fall, together with the leaves, or the flowers have at first a slight start ahead of the leaves; St. colchiciflora blossoms in autumn, but the leaves appear first in spring with the fruit, thus pointing to a former spring flowering habit, as suggested in a former paper for the similar habits of Colchicum autumnale. St. Ætnensis still flowers in May, as though to remind the investigator of the former spring flowering habit of this genus.

Leucojum. Among European species L. roseum flowers in the fall with the leaves, but the leaves have scarcely made their appearance, or have only half the length of the flowering stem when the flowers begin to unfold. L. autumnale begins to flower in the fall also when the leaves are still concealed or just commencing to peep forth from the ground. Among the spring flowering species L. trichophyllum has flowers in blossom often when the leaves are still concealed, but the leaves may at times catch up in development during the flowering period. In L. vernum a slight difference of development is occasionally noted. The other spring flowering species, L. Hernandezii, L. æstivum, L. hiemale, have the leaves fully developed during the flowering season. The retarded development of the leaves of autumn species in general finds its analogy in many spring flowering species. It is not normal for late summer flowering genera or species.

The European species of Amaryllidaceæ present other good cases of fall flowering plants, although none of the species with this habit are found in France or Italy. Thus Lapiedra Martinezii flowers in Spain in September; Galanthus Olgæ flowers in Greece in October and November with the leaves; whereas G. plicatus, and G. nivalis flower in spring, when the leaves are not yet fully developed. Some of the species of Corbularia may sometime in the future take up the habit of fall flowering. C. Bulbocodium begins to flower often in January, and C. cantabrica, even in December, but at present their flowering season continues until March.

Scilla intermedia, which probably includes Sc. obtusifolia, flowers in October and November. The leaves start to grow after flowering has begun, a fact which is also true for Sc.

autumnalis, another fall flowering species, August to October. This habit points to an origin from spring flowering species; a case which otherwise would be doubtful since summer flowering species of Scilla are not rare.

Of the twenty-three well defined European species of Colchicum only one, C. bulbocodioides, flowers in the spring; it is interesting to note that it flowers together with the leaves. All the other species flower in fall, although a variety of C. autumnale, *vernale*, has been formed upon the frequent accidental spring flowering of this species, when for some reason the fall was not favorable for its flowering. The most frequent reason is that the meadows were covered with water during the fall. Among the fall species C. Bertolonii, C. pusillum, and the ill-characterized species, C. Steveni, develop the leaves almost simultaneously with the flowers in fall. The remaining twenty species develop the leaves first during the following spring. Now the habit of blossoming before the leaves develop is so common among spring flowering species, and so utterly unknown among summer flowering ones that this habit has been considered an excellent proof for the former spring blossoming habits of the species of Colchicum. This is further attested by the development of the fruit in spring.

A few other species of European Colchicaceæ may be mentioned in this connection.

Merendera attica has the flower stems and the leaves of the same length at the time of flowering, October to November, but the latter continue growth after the flowering season. M. Bulbocodium and M. filifolia have the leaves still hidden in the ground or scarcely started during the flowering season, September to October. The leaves, however, begin to grow rapidly before winter sets in. M. bulbocodioides flowers in October and November, but does not produce its leaves until early in February. M. sobolifera and M. Caucasica flower in the spring, but slightly ahead in development of the leaves.

Bulbocodium vernum flowers in March, considerably ahead in development of the leaves. B. ruthenicum also produces flowers before the leaves are well developed.

Schott, in his revision of the genera of the Aroideæ, proposes a new genus for Arum pictum, Gymnomesium, of which he says that it flowers in autumn, before the leaves appear. The new genus Biarum is also characterized as flowering in autumn, in September, before the leaves come out; but the

leaves appear during the same autumn, only later than the flowers. Biarum tenuifolium flowers in Italy, in October. In the specimens examined, the leaves were not visible at all when flowering commenced. Schott places in the same genus the following species: B. Spruneri, Greece; B. Anguillaræ, Dalmatia; B. abbreviatum, Greece; B. Zelebori, Greece, Asia Minor; B. Russelianum, Syria. From his characterization of the genus these species should have the same habits as the species first mentioned. The genus *Ischarum* Blume, as defined by Schott, also flowers in autumn before the leaves appear. Ischarum Haenseleri occurs in Spain, I. dispar in Algeria, and eight other species in Egypt and Asia Minor. The genus Leptopetion of Schott, flowers at Alexandria, in November, contemporaneously with the leaves. The case of Arisarum vulgare is very instructive in this connection. Considering only its habits in Italy and France, it may be said to flower from February to April in the north, and from November to March in the south. In some places, too cold during the middle of winter, especially in and near France, it flowers in autumn, and again in spring, but not during the middle of winter, except during mild seasons. On the other hand, in some very warm places. in some parts of the Riviera, and elsewhere, it is locally in flower chiefly from November to January, but not in later spring.

Botryanthus parviflorus flowers in September and October, together with the leaves. Most species flower in spring, beginning often in February, and the latest flowering in June.

VI. That part of list III which is discussed under § V is considered as including only those fall flowering species which formerly flowered in the spring. Their relation to spring flowering plants is shown in different ways.

1. In quite a number of cases all the related species which do not flower also in the fall flower in spring; and there are no related summer flowering species at all. (In those cases where summer flowering species exist, this proof is wanting.)

2. In quite a number of species the flower buds blossoming in the fall are protected in scaly bulbs or in the subterranean buds borne by corms until immediately before the flowering season, and then rapidly pushed forth and developed. This is a habit which seems to remain from the time when the plants flowered in spring and it was necessary to protect the flower buds as long as possible against the cold In Hamamelis

Canadensis the flower buds remain small all summer and do not develop until late in the fall. In Hedera Helix the scaly bud enclosing the flowering umbel does not develop in equal proportion with the rest of the plant for a considerable time after its formation, and therefore shows marked retarded development at first. This points, by analogy, to the long retarded development of buds during winter, to a former spring flowering habit.

3. Quite a number of species develop their blossoms more or less before the leaves. The leaves may develop later in the fall and during the winter, or may not appear until the following spring. This habit finds its analogy among spring flowering species and suggests the former spring flowering habit of these fall blossoming species.

4. A considerable number of the species in question mature the fruit first in the spring of the following year, although the fruiting capsule or pod may develop considerably during the winter months. In many species the fruiting ovary remains in the ground during winter for protection against the cold, as heretofore described for Colchicum. In Hamamelis Canadensis the pod takes on a horny texture which protects it against the cold, and the fruit of Hedera Helix is also quite hard during winter months.

By the use of one or more of these data the former spring flowering habit of fall flowering plants may be determined. It remains to learn if the fall flowering habit resulted from the occasional reappearance in fall of the flowers of certain species flowering in spring under ordinary circumstances, or if they are cases of earlier and earlier development of spring plants. The following facts are of importance in a consideration of this question:

1. When related spring flowering species are sufficiently numerous, as for example in Crocus, Narcissus, Colchicum, Merendera and the like, one or more of the spring species will always be found to commence flowering remarkably early, thus forming a sort of a link with the fall flowering species.

2. It is not common for the related spring flowering species to flower *a second time* in the fall, although related species may *begin* to flower in the fall and *continue* blossoming until spring, either on the same plant or in different plants of the same region, or in locations successively less favorable for early flowering.

3. If the two facts just noted are more favorable to the development of fall flowering species from spring species by means of successively earlier appearance of the flowers owing to the tendency of spring flowers to blossom as early as possible, a third consideration is still more decisive in this direction. The spring flowers which accidentally blossom a second time in the fall commonly do not ripen their seeds. Now by what kind of selection are these plants ever going to acquire gradually the habit of resisting the cold, and maturing their seeds even after a quite severe winter? If on the other hand, the ancestors of fall flowering species began as ordinary spring flowers, and then gradually flowered earlier and earlier, it may be understood how all these species found some means of resisting the winter cold, and all of them gradually acquired the habit of ripening their seeds in spite of the cold, either in the spring as usual, or in the fall. It is because the habit of flowering in the fall is viewed as the result of a *gradual* development with these species, that a simultaneous development of the power of the fruit to resist cold is also readily understood.

Moreover, the development of the habit of fall flowering in the manner just cited requires that the habit of flowering in the fall should be formed in the warmer, more southern countries where it is possible for plants to blossom during the winter months under certain circumstances without being totally destroyed by the winter frosts. Now as a matter of fact these conditions are present in some parts of southern France and the countries farther south. This explains why there is no genuine fall flowering species in the sense here considered, and included in the list III, which does not have its geographical range extending into the districts of southern France, and farther south, into Italy, Spain, or Corsica and Sardinia, and also why the centre of the area of geographical distribution for these species lies usually in the more southern countries mentioned.

It is therefore believed that the fall flowering species of list III above investigated derived their habit of flowering in the fall in Spain, Corsica, Sardinia, the Riviera, Italy, or some other southern country, and that from their various places of origin these species extended their geographical range in all directions, and among others, more or less northward.

Moreover the considerations here adduced are believed to be also valid for plants showing a similar fall flowering habit under similar circumstances in other countries.

Cambridge, Mass.

Notes on the flora of Chicago and vicinity.

E. J. HILL.

From time to time the writer has furnished the BOTANICAL GAZETTE with lists of plants from the neighborhood of Chicago, and especially from the adjoining pine-barren region of northwestern Indiana, accompanied by such notes upon them and their distribution as seemed desirable. The present notes are in continuation of this work. Some of the plants to be noticed have already been mentioned in Higley and Raddin's "Flora of Cook county, Illinois, and a part of Lake county, Indiana," which appeared in the spring of 1891. Some have been detected since that time.

NATURALIZED PLANTS.—Of naturalized plants, either weeds or useful plants, the following may be mentioned:

1. *Nasturtium sylvestre* R. Br.—This European plant, well established in the Atlantic coast states, though rare, is quite abundant near Western Springs, a village nine miles west of the city. It grows along a highway north of the village, flourishing in the clay soil, and spreading from wayside pond holes up to the wagon tracks, where it is subject to a goodly amount of dryness at some seasons. Where the road crosses Salt Creek, a neighboring stream, the plants have spread in the rich, damp soil of the open woods along the creek. Some plants had gained a footing in the scanty soil lodged in the crevices of the stone masonry forming the retaining walls of the approaches to a bridge spanning the stream. A habit so unusual for a nasturtium shows its hardiness and persistence, and indicates that it has come to stay. The locality is in the midst of cultivated fields and meadows.

2. *Trifolium hybridum* L.—It is stated in the "Flora of Cook county," already mentioned, that a few specimens of this have been found near lines of railroads from the east. In 1886 I found it common in a field near Forest Hill, in the the southwestern part of the city. Clumps of it were growing in a meadow about as freely as those of red clover, and it had spread to the adjoining street. It was so plentiful as to lead one to think it may have been sown along with the tame grass of the field.[1]

3. *Medicago sativa* L.—The only place where I have met with alfalfa is in a meadow near East Chicago, Ind., where it

[1] This species is abundant near Madison, Wis, thoroughly established and spreading rapidly.—EDS.

grows spontaneously in the grass. The farm where it occurs is an old one for the locality, being cleared in early days in the pine woods, and is still encircled with timber. It is not reported elsewhere in the vicinity of Chicago.

4. *Helianthus annuus* L.—This is not the cultivated plant escaped from gardens, but one introduced from the plains. It is well established in the western part of the city, near Brighton Park and along the C., B. & Q. R. R. The locations reveal how it has been brought here, as it is seen most abundantly where the refuse from stock trains has been thrown out of the cars along the embankments, or piled in the fields. It has spread from such places into the neighboring fields, and is sharing the ground with *H. grosse-serratus*, the most common indigenous helianthus in such situations. The heads of flowers are quite variable in size, the disks an inch or two in diameter, and are mostly larger than any of our wild sunflowers, and with a different aspect.

5. *Solanum rostratum* Dunal.—I came across this first in 1886, near Liverpool, Ind., and it was reported in the BOT. GAZ., XIII, 323. The same year it was found at South Chicago, as mentioned by Higley and Raddin. In 1890 I found it at Dune Park, Porter co., Ind., along the L. S. & M. S. R. R., somewhat farther east than the station at Liverpool, on the Pennsylvania line. I have not yet seen it in any field.

6. *Amarantus blitoides* Watson.—This is now very common by the railroads and highways leading into the city. It is not difficult to determine very nearly the time of its appearance at Chicago. I noticed it at Englewood in 1875, having come here to reside the fall before. Not finding this amaranth described in the current hand-books, specimens were sent to Dr. Gray for determination, which was kindly done, and the statement added, "pretty common west." It is not mentioned in Babcock's "Flora of Chicago and Vicinity," published in the *Lens*, the last part of which was issued in December, 1873. Speaking to him about the plant sometime after it was found, he stated that he was aware of its presence south of the city, but had not seen it at the time his flora was compiled. It evidently came in from the west or south about that time, as it was not uncommon by the roadsides in Englewood in 1875. It is not given in Patterson's "Plants of Illinois" (1876), nor in the "Catalogue of Plants of Indiana (BOT. GAZ., 1881), nor in Wheeler and Smith's Michigan catalogue

(1881). As the last edition of Gray's Manual states that it has spread eastward to western New York, it has evidently gone this distance since about 1873. It is often a very vigorous grower, the prostrate stems sometimes three or four feet long, covering the ground like a mat, and producing seed in great abundance. Though the foliage resembles that of *A. albus*, the general appearance of the plant is very different from that of the globular and bushy tumble weed.

7. *Cycloloma platyphyllum* Moquin.—It is stated in Gray's Manual (6th edition), that this western plant extends to western Illinois and southern Indiana. It also occurs here and was first reported in Babcock's list (supplementary part, December, 1873), as "rare" by the I. C. R. R. In 1875 I found it growing by the C., R. I. & P. R. R., near the normal school in Englewood. Last year I saw it by the L. S. & M. S. R. R., between Miller's and Dune Park, Ind. It also occurs at the city of Evanston, north of Chicago. From its behavior, and the places where it grows, near the lines of railway, it is plainly adventive, having appeared doubtless about the time Babcock mentioned it. It is spreading eastward, and may be looked for further along on the railroad lines extending to the east. Macoun, in his "Catalogue of Canadian Plants" (1886), reports it as already in the streets of London, Ont., and remarks concerning it, "Fully established and spreading, an importation from the west."

8. *Salsola Kali* L.—Reported in Higley and Raddin's "Flora" as frequent on the lake shore at Evanston. In 1890 I obtained it in two localities east of the city, Wolf Lake and Clarke, Ind. Both are on the Penn. R. R., from a mile to a mile and a half from the shore of Lake Michigan. Evidently the plants were not derived from the Evanston locality, but were introduced in some way by the railroad, as they were close by the tracks or between the rails, and in very dry ground. Being a sea shore plant at the east, and one of river bottoms in northwestern Nebraska and central Dakota, with stations in southeastern Dakota (Yankton), and northwestern Iowa (Emmet Co.), and southern Wisconsin (Madison), the localities about Chicago are somewhat intermediate, and the plants may have been introduced from the east or west. It is clearly adventive at Clarke, and has all the appearance of it at Wolf Lake, and is so regarded by the authors of the "Flora" at Evanston.

NATIVE PLANTS.—There are a few plants of a different character, native to the region, which are worthy of mention.

1. *Desmodium Illinoense* Gray.—Found last year at Auburn Park within the limits of the city. It has been known hitherto as a plant of western Illinois and westward. From the locality where it grew it was evidently indigenous, and may occur elsewhere in this vicinity, as it is easily overlooked from its close resemblance to one or two other species of this troublesome genus.[1]

2. *Rosa setigera* Michx.—In the summer of 1890 I came across a few bushes, or clumps of bushes, of this rose at Willow Springs, in the southwestern part of Cook county, Ill. They were on the wooded hills which rise abruptly on the east side of the Desplaines river. They grew on the borders of rather wet spots, covered with sedge and coarse grass, little prairie-like openings often seen in the woods which crown the low drift-hills of this region. None of them were climbing, being too far from any support. Some of the growing shoots of the season, arching over and with the ends trailing on the ground, were six to eight feet long by the middle of July. Being in full bloom, with some of the masses of bushes several yards across, they presented a very attractive appearance, as it was my first sight of the climbing rose in its wild state. The first impression was that they were escapes from cultivation, but a careful examination of the locality led to a different conclusion. A year later the species was found on the west side of the Desplaines, a couple of miles below. In a narrow strip of woods between the river and Flag Creek, which enters it at this point, they occur plentifully, clambering over shrubs and climbing small trees. These stations seemed to have eluded the vigilance of local collectors, for the species had hitherto the following record for the vicinity of Chicago: "But two specimens have been found, one at Morgan Park, the other at Desplaines." In Patterson's catalogue of the plants of Illinois its most northerly locality reported was Peoria county, where Dr. Brendel found it. All of these stations are in the basin of the Illinois river, or close by, the Desplaines being its tributary, and Morgan Park being situated on the dividing ridge between it and Lake Michigan. The prairie rose is rare in Michigan, though one of its common names is the Michigan rose, but is considered indigenous there.

[1] Reported as found at Ann Arbor, Mich., in Beal and Wheeler's Michigan Flora (1892).

3. *Rosa Engelmanni* Watson.—Specimens of this were obtained last year at Pine, Ind., with oblong-obovate fruit. Those seen before in this vicinity have nearly always had oblong fruit, as mentioned in a former communication to the BOTANICAL GAZETTE (XV, 310.) The canes were from four to eight feet high, and closely resembled in foliage and fruit taller examples of this rose seen at Vermilion Lake, Minn., in 1889. As compared with *R. blanda*, it is usually a taller and more robust shrub, with abundant leafage, the stems, particularly the lower part, often densely covered with fine prickles. It prefers damper and generally more shaded situations, approaching in this respect *R. Carolina*. It partakes of another character of *R. Carolina*, which is not so common In the case of *R. blanda*, that of frequently being massed in iarge clumps, and occupying the ground quite exclusively. I detected this rose last year at Rogers Park, near the lake shore in the northern part of Chicago.

4. *Cacalia suaveolens* L.—Found in a single locality by the Calumet river, near Porter, Ind. It has not before been reported from this part of the state, nor from the vicinity of Chicago, though said by Dr. Phinney to be common in the eastern-central part of Indiana. Only one locality is assigned to it in Michigan, on the authority of Winchell's catalogue.

5. *Epigaea repens*.—Though common at Michigan City, Ind., and extending from there north through Michigan, this plant has lately been found coming farther west around the head of Lake Michigan. Near the mouth of West City creek, north of Porter, it grows in the open sandy woods along the lake. As this stream drains the swampy land lying between the two lines or ridges of sand hills which here run somewhat parallel with the shore, it may extend up the stream still farther towards the west. In the Catalogue of Indiana Plants it is reported from Lake co., Ind., but none of the local lists give it, nor do I know of its presence here on the authority of collectors from this vicinity. Though a frequent plant on the east side of Lake Michigan, especially as one goes north, it seems to be rare on the west shore, or entirely absent, until the northern peninsula of Michigan is reached, whence it extends westward around Lake Superior into Minnesota. It has been reported from Beloit, Wis.

6. *Quercus Muhlenbergii* Engelm.—This oak comes into our

lake flora sparingly, being found by Wolf Lake just east of the Indiana line. The soil is sandy and of little strength, so that all the trees are small. They are scattered over an area of a few acres, and are quite isolated in their position. Southwest of the city this oak occurs again on the Desplaines below the mouth of Flag Creek. In the rich soil of the bottom land it makes a large tree. These are the only localities near Chicago where it is at present known to grow. About fifty miles south it is not uncommon by the Kankakee river. *Q. imbricaria* comes a little further north along the Desplaines and Flag Creek, thence extending south to Joliet and beyond.

7. *Eleocharis quadrangulata* R. Br.—Abundant in the shallow water of Wolf Lake, but within the city limits. In the Manual its range is not extended west of Michigan. It has been found in Illinois and Missouri in the vicinity of St. Louis. In Wolf Lake it very fully occupies the ground where it grows, preserving the character Elliott gives it in his "Sketch," (I, 79.) "In rice fields it becomes a very injurious intruder, as its thick creeping roots occupy the ground, and permit nothing to grow where they extend."

8. *Eleocharis olivacea* Torr.—While looking the past season for *E. capitata* R. Br., since the only station where it had hitherto been seen, at Whitings, Ind., seemed likely to be destroyed by the works of the Standard Oil Company, I found it again about a mile from the original locality. The new station is on the borders of Lake George. With it *E. olivacea* was also found. Both are quite plentiful in patches in the wet, marly sands in which these shallow lakes abound, since the fresh water mollusks are so prevalent that their comminuted shells form a whitish marl. Such a soil affects the flora to some extent. It is in this fine mud, a mixture of sand and calcareous earth, that these two species of Eleocharis grow. Both are densely cespitose, forming small tufts. The stems of *E. capitata* are erect or ascending, from half an inch to seven or eight inches high, and form fibrous, annual roots, while those of *E. olivacea* are diffuse or subdecumbent, from two to four inches long, and grow from a perennial rootstock half an inch to an inch in length. They fruit about the same time, the latter part of August and in September. Both are largely plants of the Atlantic coast region. *E. olivacea* extends to western New York and by Lake Erie to Erie, Pa. It is also said to occur

in Michigan. In Indiana it is reported from Gibson county, in the southwestern part of the state, and the station at Whitings places it in the extreme northwestern part.

9. *E. intermedia* Schultes.—This species also was obtained with the two just mentioned. It has been noticed but once before in our vicinity, at Hyde Park. The stems are considerably shorter than those usually described, being but two to four inches long. They are spreading or declining, densely cespitose, many small bunches making a large, compound tuft. I do not find it reported for Indiana, though it is found in Michigan, northern Illinois, Iowa, and northward. *E. acicularis*, everywhere common, grew with the three species named above, and the four could sometimes be collected within the area of a square yard.

Englewood, Chicago.

The plea of expediency.

N. L. BRITTON.

Inasmuch as Dr. Sereno Watson has in his last published words (BOTANICAL GAZETTE, June, 1892) defined his position and that of Dr. Gray, on the question of nomenclature, as one of expediency, it is desirable that this position be briefly examined.

It is very clear from the manner in which these botanists have illustrated their position in their writings, that it has been an individual rather than a general one. By this I mean that what has appeared to them "expedient" is the course which has been followed quite independently of what others may have so regarded, and it is this spirit which has led to all the antagonism which has been developed on the question of what specific name a plant should bear, as well as in many other questions during the last twenty-five years.

This epoch has been forcibly defined in a late issue of the GAZETTE (p. 164) as one of "'a botanical aristocracy," during which there has been a good deal of "rank injustice done to both worthy but unknown, and known but underrated botanists." Coming from the source that this pungent statement does, from one who has been more closely identified with the

work of the "botanical aristocracy" than any one else,[1] it must be accorded the greatest weight as an indication of the thoughts that have been rather freely expressed in private, and which have done systematic botany no good. A proper consideration of the wishes and opinions of others would have served science immeasurably better and redounded to the credit of those who were so well equipped to facilitate the development of botany in America.

As to the maintainance of the oldest binomial, the principle which Dr. Watson avers has been followed, so many exceptions have been taken in Gray's Manual and Synoptical Flora, that we perceive the principle of expediency has been made to work both ways. I will not refer to these in detail at the present time, but they may be illustrated by such well-known species as *Jeffersonia diphylla* (L.) for which Barton's binomial of *J. binata* is much older; and *Eclipta alba* (L.) taken up instead of *E. procumbens* Michx. Quite a long list of these could be given to show that the "aristocracy" of the GAZETTE did not hesitate to abandon its own avowed principles when deemed expedient. Now with these facts before us, when the time came that two or three American botanists not controlled by the "aristocracy" were by nature impelled to think for themselves, there were about two courses open to them. The one was to accept the recommendations of the Paris Congress of 1867, and other representative deliberative bodies which had considered the nomenclature question, and decided that the earliest specific name should be maintained; the other was to follow what has been termed the "Kew rule" of maintaining the oldest binomial. It is not worth while to discuss here the merits of the two systems; that has been repeatedly done by adherents of each. We saw that the rule of 1867 had the support of more botanists of eminence than the other and it appealed to us as the proper course. Its very general acceptance outside of the "botanical aristocracy" during the last five years has I believe fully demonstrated the wisdom of our choice. The opinion of the leading spirit in the Paris Congress of 1867 does not accord with Dr. Watson's idea that this is not an *ex post facto* law. It would indeed be ridiculous to have it so.

[1] Dr. Britton is of course at liberty to make his own use of this editorial. The editors, however, beg leave to dissent both from his imputation of it to any one of their number, and from his special application of it in the case under consideration.

For some reason which I am wholly at a loss to understand, Dr. Watson found it expedient to intimate that I have withheld from publication a letter on this matter written by Dr. Gray. The facts in this case are just these. Immediately before his fatal illness, Dr. Gray wrote me a long personal letter objecting to the course which I had taken in maintaining one of Walter's specific names, dating from 1788, which was cited in Dr. Watson's Bibliographical Index, as a synonym of one published by Torrey and Gray in 1840. The citation is made by Dr. Watson without any question being thrown upon the equivalency, and I supposed it to be true, but in this letter Dr. Gray threw doubt on it, and informed me of an earlier specific name by Linnæus, which I took up on the next occasion I had to refer to the species. Some time after Dr. Gray's death I was requested to send this letter back to Cambridge as the physicians attendant on Dr. Gray desired to have a study made of the hand-writing. This I immediately did. Later I was requested to allow the letter to remain at Cambridge and accept a copy of it in exchange. As the last writing of a distinguished botanist I naturally valued the document, but acceded to the request, and the original is not in my possession. The letter did not come to me as editor of the *Bulletin* of the Torrey Botanical Club, for I was not then editing that journal. I did not realize that it was intended for publication, and do not think that it was. At any rate under the circumstances stated above, I certainly never had any right to publish it after it had passed from my possession, and there was no principle enunciated in it which was not already well-known as being held by the writer.

Columbia College, New York City.

BRIEFER ARTICLES.

On Amarantus crassipes. (WITH PLATE XVII.)—Schlechtendal publishes the first description of this specics in Linnæa VI (1831), p. 757. Schrader, in Index Sem. hort. Goett. (1835), described this plant as *Scleropus amarantoides.* Shortly afterwards Endlicher, in Gen. Pl. Suppl. (1836–1840) p. 1377, published a description of Schrader's genus. Moquin, in DC. Prodr. XIII, 2, (1849), p. 271, retained the generic name, but restored the first specific name. Dr. Gray, in Proc.

Am. Acad. v (1862), p. 169, remarks that "the genus *Scleropus* was evidently founded upon an abnormal character, a thickening of the peduncle and pedicels, which occurs in various Amarantaceæ. Schrader's [it should be Moquin's] *S. crassipes* is an *Euxolus*, etc."

Bentham and Hooker, in Gen. Plant. (1883), p. 29, accept Dr. Gray's opinion, and include this plant under *Amarantus*, together with *Euxolus*, *Mengea*, *Amblogyne* and other of Moquin's Prodromus genera. Finally, Hemsley, in Biol. Cent.-Am. III (1882–1886), p. 14, includes this species with all its synonyms under *Amarantus polygonoides*.

A mere glance at the two plants is sufficient to excite doubt as to the correctness of this course. Closer inspection leads to positive certainty that Schlechtendal's plant, while remarkable for the thickening of its peduncles, is not an abnormal condition, and is specifically distinct from the plant with which Hemsley has united it.

In the first place, the histological investigation of these incrassate peduncles shows normal tissue. Certainly the thickening is not due to insect or fungus work. And the idea that we have here a case similar to the fasciation in the coxcomb, for instance, is refuted by the *uniform dichotomy* in the short clusters of inflorescence, sessile in the axils of which are the pistillate flowers. In this particular, as indeed in the entire description of this plant, Schlechtendal is scrupulously correct. He expressly mentions this thickening as constant in a large series of specimens before him. These were all from the island of St. Thomas, in the West Indies. The specimens in the National Herbarium comprise Wright's Cuban plant number 2033, Curtiss' Florida plant number 2378, Blodgett's Florida plant, Letterman's Texan plant *in part*, Dr. Mohr's Alabama plant, and Simpson's Florida plant number 482, collected this spring. It thus appears that this peduncular thickening is as constant, both in time and in geographical distribution, as it is remarkable.

But, apart from these striking peduncles, the plant has flower and fruit characters that entitle it to specific rank. The spatulate sepals of its pistillate flowers have *one* green mid-vein; the ovary has *two* styles; the ripened utricle is *indehiscent.* In *Amarantus polygonoides,* on the other hand, the sepals, also spatulate, have, in addition to the mid-vein, *two lateral* veins; the ovary has *three* styles; the ripened utricle is *circumscissile.* The seeds also of *A. crassipes* are one-third larger than those of *A. polygonoides.*

Schlechtendal found no staminate flowers in his plants. The later authors state that they occur solitary in the axils of the upper leaves. The writer has uniformly found them solitary at the base of the flower

clusters toward the upper part of the stem. The sepals are four, occasionally five, narrowly triangular-lanceolate, with a green mid-vein; the stamens are three, as described, but sometimes only two, rising from a small round disk in the bottom of the calyx; the two-celled oblong anthers are little shorter than the filaments.

As to bracts: the author of this species states correctly that the branches of the inflorescence are each subtended by an ovate-triangular, acute, small, appressed bract marked by a green mid-vein. This reaches up to the one flower which terminates each branch, and is the only bract that can be considered as belonging to that flower. Yet the flower is distinctly jointed to its pedicel *above* the bract; so that strictly speaking it is the pedicel, and not the flower, that is uni-bracteate. Endlicher, Moquin, and their followers, describe the flowers as *tri-bracteate*, an error which seems to have arisen by looking only at the terminal flowers of each cluster. For only in that case are there three bracts, one subtending the branch on which the flower rests, and two, opposite each other, subtending the rudimentary continuation of the dichotomy. See fig. *e*, plate XVII.

Another error, also initiated by Endlicher, is the statement that the style is "very short," and the stigmas "two, filiform." The artist has drawn these parts correctly in the accompanying plate. And the author of this species is here also right when he says, "Styles two, diverging, curved outward, stigmatic all down the inner side." These stigmatic surfaces are under the lens densely long-papillose. Fig. *g* shows the direction of styles at the time of blooming; figs. *f* and *k*, at the time of maturity. The author evidently described them in the young state.

By its spatulate sepals this plant is related to the section *Amblogyne;* by its warty, indehiscent utricle, to *Euxolus;* by its uni-bracteate flowers, to *Mengea*. But by its other characters it is distinct from all, and deserves to stand in a section by itself, § SCLEROPUS, under its *first* name, *Amarantus crassipes* Schlecht.—JOHN M. HOLZINGER, *Department of Agriculture, Washington, D. C.*

EXPLANATION OF PLATE XVII.—Fig 1. Upper part of a plant of *Amarantus crassipes*, nine-tenths natural size, showing mucronate apex of leaves. Figs. *a, b, c, d*. Flower clusters showing the mode of inflorescence Fig *c* is from a younger flower cluster with pedicels not yet fully incrassate. Fig. *e*. Terminal flower, with "three bracts." Fig. *f*. A pistillate flower, with mature utricle, with part of subtending bract on the pedicel. The joint under the flower is also shown. Fig. *g*. A younger pistillate flower, the pistil separated from the calyx. Figs. *h, h'*. A sepal of this plant, and of *A. polygonoides* respectively. Figs. *i, i'*. Seeds of these two species. Fig. *k*. A pistillate flower with a staminate flower at its base. Fig. *l*. Part of a staminate flower showing the small disk at the bottom of the calyx.

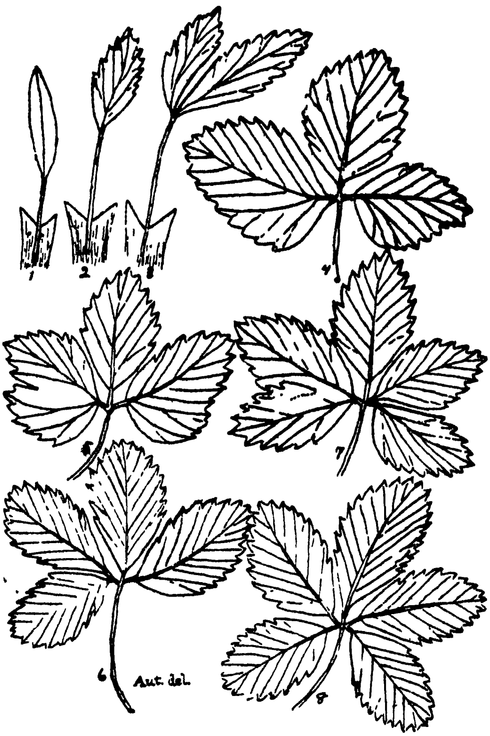
Interesting variations of the strawberry leaf.—The strawberry, both wild and cultivated, is perhaps considered less inclined to variation of foliage than many of our common plants. I have often sought in vain among them for an abnormal leaf. There are so many strawberry leaves in which the lower portion of the two lateral leaflets is conspicuously enlarged, that one is led to expect the advent of additional leaflets. In other words it sometimes appears as if nature were planning to inaugurate a five-leaved form. There is often apparently overgrowth sufficient to form an extra leaflet. Indeed the lateral leaflets become so lopsided, on account of this excessive growth, that symmetry demands that the lower portion be cut off and made into a separate leaflet. Plants all about us are moulding their leaves in accordance with changing conditions. They have found by long experience in the struggle for life, that, oftentimes, many small leaves serve their purpose better than a less number of larger ones. And so we find many entire leaves indenting their margins; lobed ones becoming more deeply lobed; still others, by what we may term an evolutionary process of division, give rise to new or additional leaflets. From the lateral leaflets of the strawberry, for instance, other leaflets might be expected to be evolved or developed.

This process may be observed in very many of our common plants; it was therefore with much pleasure that the conservative strawberry was, this past season, found falling into line with other progressive plants. In a small strawberry patch some thirty or forty large, vigorous, thrifty looking leaves were found which had progressed beyond the present trifoliate form. The new or added leaflets appear, just where I had hoped to find them, on the lower side of the lateral leaflets, where the surplus growth seems to have been made in anticipation of such a forward step. Figs. 5, 6, 7 and 8 (reduced one-half) represent a series of these leaves. Many more gradations might be shown were there space sufficient. But these will serve to illustrate that the strawberry is not standing still; that it is moving along the same lines traversed by the blackberry, the Virginia creeper, etc.

The finding of these "abnormal" leaves, brought to mind some interesting leaves of Fragaria Virginiana, var. Illinoensis, which were collected near Lexington, Ky., some ten years ago. Figs. 1, 2 and 3, (half natural size) represent gradations of these suggestive leaves. Duplicates were sent to Dr. Gray at the time, but he considered them "merely abnormal forms, which sometimes occur."

Is it not possible, however that the single leaf, fig. 1, is the primitive or ancestral type of our present trifoliate form? Evolution carried this type to the plane upon which we find fig. 2, in which the crenate-

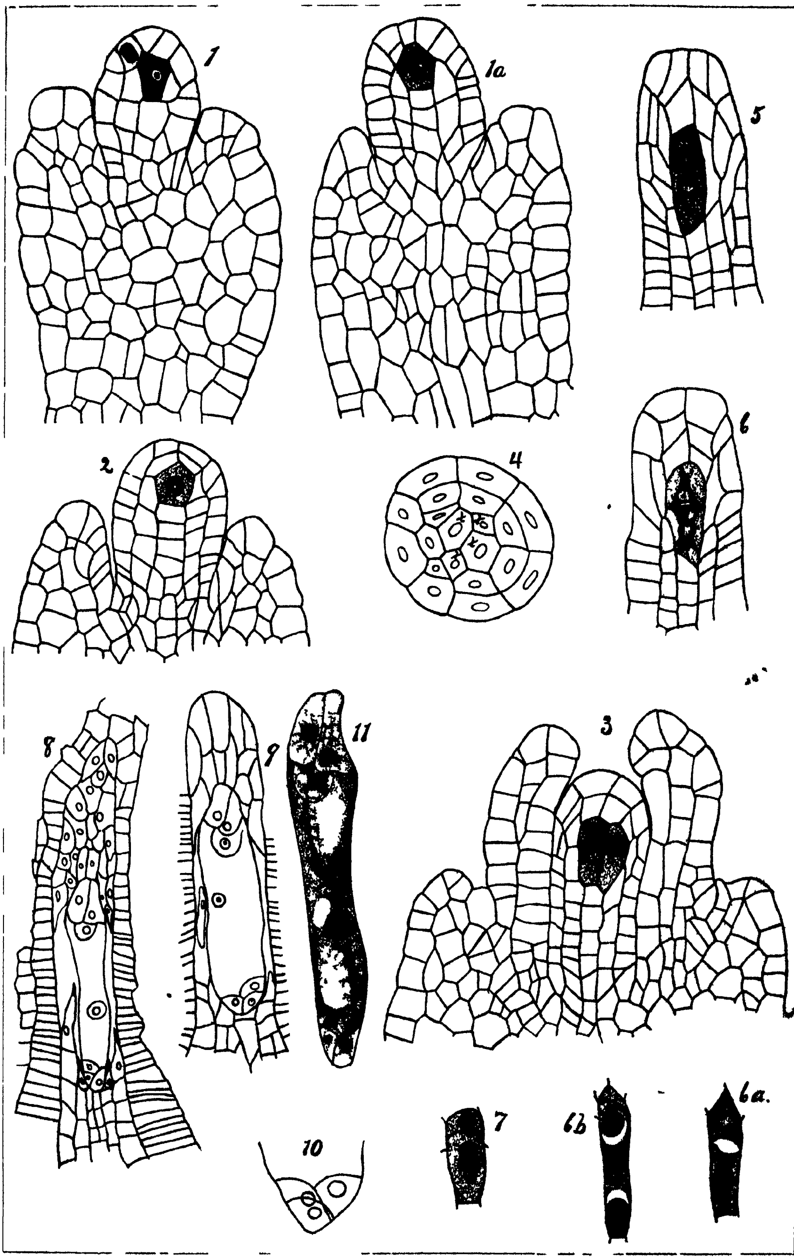
dentate margin has been added; larger, stronger veins have been formed and it is really become a strawberry leaf. Did not this single leaflet, in the sometime of the past, give off the two lateral leaflets, making it trifoliate? Does not fig. 3, give us an affirmative answer to our question? The transition forms (figs. 5, 6, 7,) have followed the same law in the development of these added leaves, which was suggested in the development of the trifoliate from the ancestral type. Descriptions of leaves ordinarily cover but the golden mean. Fig. 4 is the only one which is recognized as having a legitimate place among the leaves of the strawberry. The others are either "poor relations" which should remain in the background, or are too prosperous to remain in the humble household.



VARIATIONS OF THE LEAF OF THE STRAWBERRY.

But the leaves tell their own story so simply and so well that one needs but to give ear unto it in order to understand the progressive steps from the primitive leaf up to the possibilities of the future represented by fig. 8.—MRS. W. A. KELLERMAN, *Columbus, Ohio.*

On the development of the embryo-sac of Arisæma triphyllum. (WITH PLATE XVIII.)—The origin of the angiosperms and the true relationship between monocotyledons and dicotyledons are among the problems now demanding the attention of the botanists. From our present knowledge the monocotyledons may be regarded as the more primitive group from which the dicotyledons have been derived, or the dicotyledons may be looked upon as the primitive group, and the monocotyledons as degenerate forms derived from them. It seems highly probable, however, that one or the other is the correct view;



MOTTIER on ARISÆMA

for in every representative of both groups, as far as is known to the writer, there is to be found the typical seven-celled embryo-sac, and it is hardly possible that such a structure could have arisen independently in both groups. If in any representative of either of these two groups of plants an embryo-sac should be found varying considerably, or even a little from the type, something toward a solution of the problem would at least be suggested. It is perhaps, among the lower forms that we are to seek such variations, if there are any. With this in view work was begun upon the development of the embryo-sac in Arisæma triphyllum. Although no variation from the common type in the structure of the mature embryo-sac was found, yet a few details in the process of development from the initial cell seem worth mentioning

The initial cell (mother cell) of the embryo-sac arises as a single hypodermal cell in the apex of the nucellus (figs. 1, 1*a*). This cell is well defined as soon as the first traces of the inner integument of the ovule is perceptible, or even sooner. All the cells now increase in size, and those of the epidermis divide by periclinal walls (fig. 2). The initial cell next divides by longitudinal walls into three or four cells two of which may be seen in longitudinal section (fig. 3). A transverse section at this stage of development shows four cells (x) which in all probability were derived from the initial cell. As far as is known to the writer, the longitudinal division of the initial cell of the embryo-sac has been observed and recorded only by Strasburger.[1] This author calls attention to a very unusual state of things in Rosa livida, where about four cells of similar size may be seen in longitudinal section.[2] He also states that he has seen two cells in longitudinal section, but he does not say in what plant or plants it was observed. One of these cells now enlarges considerably (fig. 5), and divides by a cross wall into two cells (fig. 6), the lower one being usually larger than the upper. The lower now absorbs the upper (fig. 7), and develops in the usual manner into the embryo-sac (fig. 11). (The intervening steps in the process are omitted here since they correspond to those of the type.) In the instance represented in fig. 6 the cross wall is only slightly swollen. In but one instance was the cross wall found to be greatly swollen (fig. 6*a*); in all other cases it was always of a more delicate structure, but not appreciably swollen. One instance was observed where there was no cross wall formed, the cell being slightly elongated with a large nucleus in each end and each nucleus accompanied by a vacuole as shown in fig. 6*b*. This, however, must be of very rare occurrence, for in the large number of successful preparations made at this point in the de-

[1] Die Angiospermen und die Gymnospermen, p. 14. 1879.

[2] l.c. p. 14, taf. IV, fig. 50.

velopment, either the nucleus was found in some stage of division, or a distinct wall was present.

During the development following the stage shown in fig. 7, the tissue of the nucellus surrounding the developing sac laterally is rapidly disorganized and absorbed, so that when the embryo-sac is mature, only the apical portion and a few plerome elements of the nucellus, together with the remains of a few disorganizing cells are to be seen. Embryo-sacs in ovules near the wall of the ovary are more elongated (fig. 8) than those of centrally placed ovules (fig. 9). This is due, of course, to pressure against the wall of the ovary mainly.

The position of the antipodal cells varies here as in almost all plants. In some cases all three appeared to lie side by side, others as shown in fig. 10.

It gives me great pleasure to express my sincere thanks to Dr. Douglas H. Campbell, of the Leland Stanford University, for numerous suggestions given me in this work.—DAVID M. MOTTIER, *Indiana University, Bloomington.*

EXPLANATION OF PLATE XVIII —Figs. 1–3, longitudinal sections of the upper part of young ovules; 1 and 1*a*, × 206; 2, × 196; 3, × 236. Fig 4, transverse section of a nucellus at the point of growth shown in fig 3; *x* are cells derived from the initial cell, × 310. Fig 5, longitudinal section ofthe nucellus, the nucleus of the embryo-sac, mother cell in process of division, × 236. Fig 6, similar to 5; the devision has been completed, × 206. Fig. 6*a*, similar to the shaded part of fig. 6 with the cross wall much swollen, × 236. Fig. 6*b*, similar to 6*a* with no cross wall Fig 7, the lower cell has become large through growth, × 236 Fig 8, and 9, embryo-sacs with nucellus and portion of integument cells, × 136. Fig 10, antipodal cells of embryo-sac, × 236 Fig. 11, embryo-sac of 8, × 236.

EDITORIAL.

OUR READERS will, perhaps, remember that two years ago (July, 1890) we mentioned the undertaking of the Commissioner of Education to report the condition of biological instruction in the colleges of this country. That report, long-looked-for-come-at-last, is somewhat disappointing. It is probable that the compiler, Dr. John P. Campbell, is not to be blamed for the tardiness of its publication. But the delay in the Government Printing Office has robbed it of much of its value, for the conditions have had time to change materially since the 1889–90 catalogues, on which it is based, were issued, and we know that, in some institutions, they have been changed much for the better. For the lack of digested and tabulated information, however,

we suppose the compiler *is* responsible. A hundred pages are devoted to a detailed account of the courses in botany and zoology offered in 112 colleges. Finding difficulty in tabulating these facts, because of the large amount of electives in the better colleges, the compiler selects forty-five of those in which the courses are prescribed, makes his tables and draws his deductions largely from them! These forty-five include such as Amity, Georgetown, Iowa, Illinois, Lenox, Moore's Hill, Parsons, Scio, and Simpson colleges, and Lombard and Union universities, to rank among which Amherst, Dartmouth, Lafayette and Princeton must feel proud!

DIFFICULT AS such tabulation might be, it was in *comparisons* that the value of the report might be expected to lie. What courses are required for entrance, what courses are required before graduation, what definite courses are open to the student, and what facilities are possessed, both in the way of men and apparatus for giving these courses, ought to be clearly set forth. Had this information been put in easily available form, we might hope that those prominent institutions which are so wofully remiss in offering instruction in botany and zoology would be brought to a realizing sense of their shortcomings, and be thereby forced to a reformation. But in the chapters which discuss the school and college courses, we have only generalities. We need something more specific than a statement that "a large proportion of our colleges are really doing little more than school work in science. . . The average graduate from such a college is not prepared to conduct the simplest school course in botany." What boots it to say that "out of 111 colleges there are but forty-one in which the biological departments are in the hands of men who have no other teaching?" We want not only to know that, but which the forty-one are, and of those, which have separate professors of botany and of zoology. Why tell us that "there are not more than five or six institutions in the country that furnish students with the means of performing even the simplest experiment in either animal or vegetable physiology" if we have to look through 100 pages to find out which they are?

We recognize the difficulties in the way of presenting a bird's eye view of complicated facts; but it is far from impossible. We could have spared the quotations from various gentlemen about the value of biological training, etc., as well as the history of early biological investigations, far better than we can spare the proper digesting of the facts.

DR. CAMPBELL is, we think, inclined to ascribe too much influence to Johns Hopkins University when, speaking of it as a trainer of

teachers, he says: "Botany has, perhaps, been more influenced than zoology, as is evidenced by the fact that laboratory work is much more general than formerly, and, further, that courses in cryptogamic and physiological botany are now given in colleges where attention was formerly limited to flowering plants." Just how an institution, in which biology is a *nom de guerre* for zoology, has been so efficient in improving the instruction in botany, is not apparent, and the few institutions in which botany, not to specify cryptogamic and physiological botany, is taught, have *not* been supplied from Johns Hopkins.

CURRENT LITERATURE.

A monograph of the Fontinalaceæ.[1]

We are glad to note the publication of this work, in which M. Jules Cardot endeavors to clear up the perplexing forms of our water mosses. The contribution is all the more welcome because the group is one which has its home in our own country, for of the forty-three species of the family, no less than thirty occur in North America, of which twenty-one are endemic.

M. Cardot recognizes six genera, arranged in two tribes. The Fontinaleæ include Hydropogon, Cryptangium, Fontinalis and Wardia; the Dichelymeæ include Brachelyma and Dichelyma. The genus Fontinalis of course contains the bulk of the species. The other three of the first tribe are monotypic, Hydropogon and Cryptangium coming from tropical America, while Wardia belongs at the Cape of Good Hope. Brachelyma is revived to receive our Dichelyma subulatum, while Dichelyma consists of four species.

A notable feature of the monograph is the mode of indicating the rank of the species. They are designated as of four orders. Those of the first order have the greatest assemblage of characters by which they can be discriminated, those of the second order have a smaller assemblage of such characters, and so on. Fontinalis Neo-Mexicana, for example, is a specics of the third order, being much more poorly marked than F. antipyretica of the first order. This does away with subspecies and is much more satisfactory. Varieties are recognized as subordinate forms under species of any rank.

The full citation of synonymy, exsiccati, and geographical distribution, and the extended descriptions and remarks all combine to form

[1] CARDOT, JULES.—Monographie des Fontinalacées. Extrait des Mémoires de la Société nationale des Sciences nat. et math. de Cherbourg, tome XXVIII. 1892. 8vo, pp. 152. Separates 6 fr. 50.

a most excellent piece of work, which is made thoroughly available by a good index. A few separates only have been printed which can be procured of the author at Stenay, France. (See also this journal, *ante*, p. 31.)

Botanical micro-technique.

The constant advance which is now making in the investigation of plant structures demands frequent revisions of the books dealing with the methods of such investigations, and gives opportunity for the making of new ones. Strasburger very successfully combined a laboratory manual with an exposition of technique, a plan which has its disadvantages. Dr. Zimmermann, privat-docent in the University of Tübingen, has produced a book dealing wholly with technique[1], in which he bas brought together the most approved and modern methods of preparing, imbedding, cutting, staining and mounting histological material.

The first section gives an account of the general methods of research; the second describes the organic and inorganic compounds occurring in plants and the reactions by which they can be detected; while the third gives an account of the special methods applicable to the investigation of cell walls in their various modifications and to the protoplasmic cell contents and inclusions. There is some overlapping in these sections naturally, but probably as little as could be expected between any divisions of the subject. A very short appendix mentions some special methods applicable to the examination of bacteria. The study of these organisms has become so much of a specialty and has such an amount of technique that the author wisely leaves this field to others.

The work before us is more complete than those of Poulsen and of Behrens, its two predecessors. If it is inadequate anywhere it is in the paragraphs on the methods of imbedding and section cutting. The arrangement and full index render it exceedingly easy of reference, which in so far enhances its practical value.

Spite of the fact that it would too soon be out of date, it would be well to have it translated into English. It could certainly be made far superior to the cumbersome and costly American edition of Behrens' Guide, and it is much more exhaustive than Trelease's Poulsen, which is almost the only book in English now available.

---

[1] ZIMMERMANN, A.—Die botanische Mikrotechnik; ein Handbuch der mikroskopischen Präparations-, Reaktions- und Tinktionsmethoden. 8vo. pp. x, 278. figs. 63. Tübingen: H. Laupp'schen Buchhandlung. 1892. M. 6.

Minor Notices.

BULLETIN 38 of the Cornell Experiment Station[1] is devoted to an account of the cultivated native plums and cherries, by Prof. L. H. Bailey. The thorough treatment of the subject and the admirable illustrations keep this bulletin fully up to the rank of its predecessors. Ninety-five varieties are referred to their botanical sources, while forty-four remain still uncertain to the author, being known only from literature or the descriptions of correspondents. From this paper it appears that we have the following native species in cultivation: *Prunus Americana* Marsh., with 45 varieties; *P. hortulana* Bailey and its var. *Mineri*, with 27; *P. angustifolia* Marsh. (*P. Chicasa* Mx.), with 18; and *P. maritima* Wang. with 1. The value of *P. subcordata*, the wild plum of the Pacific coast is yet to be determined. The cherries are treated in a similar manner, but more briefly, since few of the natives have been extensively cultivated. There is an attempt to unravel the tangle regarding *Prunus pumila* of Linnæus and its eastern and western forms, which Prof. Bailey thinks distinct.

TEACHERS in both country and city schools (and in many colleges too) will find the "Elementary Botanical Exercises" recently issued by Dr. Charles E. Bessey[2] most suggestive and helpful. It will help those who would like to see their pupils at some more fruitful work than the memorizing of descriptive terms and the "practice of a few diagnoses." The keys to the lower plants near the end will be specially useful to those who find themselves helpless as far as ordinary text-books are concerned when any but flowering plants are studied. The key-note of the booklet is struck in these sentences from the first pages:

"Botany is *not a book;* much more is it *not a little book.*" "Botany is the study of plants, not the study of books. It is making the personal acquaintance of the structure, reproduction, habits, uses and relationships of plants; not a study about plants. When the inquisitive boy digs up his mother's flower seeds in order to see how they grow, that is botany in the scientific sense; but when he memorizes a chapter on 'germination' in a text-book, that is not botany at all."

PROF. MOSES CRAIG, the botanist of the Oregon Experiment Station, has prepared a bulletin on "Some Oregon weeds and how to destroy them." There are brief descriptions of about thirty weeds, accompanied by wretched illustrations, with directions for destroying each that any body of sense would know. Beyond compliance with the absurd law which requires stations to issue a certain number of bulletins each year, we fail to see the value of such publication.

---

[1] pp. 73. 8vo. June 1892.

[2] Published by J. H. Miller, Lincoln, Neb., 1892, 12mo. pp. 50. 35 cents.

In the report of the Michigan Horticultural Society for 1891, Mr. A. A. Crozier gathers a host of opinions relating to the mutual influence of the stock and graft. The literature quoted bears on the various phases of the subject, such as change in habit, earliness, character of the fruit, disease, variegation, hardiness, etc. While the testimony is often conflicting and some of it doubtless untrustworthy, Mr. Crozier has done well in collecting what has been written on the matter, as the first step towards his experimental study, which we trust will shed more light on this interesting topic.

Dr. Roland Thaxter publishes in the *Proceedings* of the American Academy of Arts and Sciences a paper which "includes the additions which have been made during the season of 1891 to the previously recorded species of North American Laboulbeniaceæ, a small number only of new forms being reserved for later description for lack of sufficient material. Three new genera are represented,—Ceratomyces by two species, Corethromyces and Acanthomyces each by a single species. The genus Heimatomyces, formerly including a single European form, contributes ten species, nine of them new; while, lastly, the genus Laboulbenia adds sixteen species, thirteen of which are undescribed. In all thirty species, by which the sum total of American forms is increased to forty-nine. . . . The contribution of aquatic forms is of especial interest, the genus Ceratomyces forming a distinct departure from previously described generic types." The descriptions are full, but without figures.

As a bulletin of the Agricultural Experiment Station of Tennessee, Prof. F. Lamson-Scribner has issued the first part of a manual of the grasses of Tennessee.[1] "This first part is designed for the farmers and agricultural students of the state; affording the former a handy reference book for general information as to the general character and quality of our grasses, and giving the latter a concise account of the characters of the grass family, together with a key for determining the tribes and genera into which the species are classified." There is included in this part an alphabetical list of the native and introduced or cultivated grasses of the state; a series of illustrations, with descriptions thereof, for affording explanation of the technical terms; characters of the grass family, with a key to genera; and, lastly, a list of the books and pamphlets on this group accessible at the station. "In part two it is proposed to fully describe, and, so far as possible, illustrate all of the grasses of the state. Part one is introductory to this."

---

[1] Lamson-Scribner, F —The grasses of Tennessee. Bulletin of Agric. Exp Station of the Univ of Tenn., vol. v., no. 2. 8vo. pp. 30–113 Apr., 1892.

THE GEOGRAPHICAL distribution of the liverworts of northern Norway is comparatively little known. To aid in the elucidation of this subject, Dr. H. Wilh. Arnell undertook extensive journeys through that region in the summer of 1891. He has brought together the results of his studies and examination of literature in a quarto pamphlet, under the title "Lebermoosstudien im nordlichen Norwegen," giving an account of the vertical and superficial distribution of 115 species. It may be obtained of the author at Jönköping.

PROF. J. G. LEMMON, of Oakland, California, has published a "handbook of West-American cone-bearers." It contains brief popular descriptions, and also attempts to establish approved English names. In the great confusion of names in local use the attempt deserves success, and no one is better fitted to speak of Pacific forests than Professor Lemmon.

PROFESSOR L. H. BAILEY has published an excellent paper on cross-breeding and hybridizing.[1] The philosophy of the crossing of plants is considered with reference to their improvement under cultivation, and a brief bibliography of the subject is given. The paper was originally given as a lecture before the Massachusetts State Board of Agriculture.

DR. C. HART MERRIAM has published a list of the plants of the Pribilof or Seal Islands[2] (Bering Sea), based upon specimens collected from July 28 to August 10, 1891. The collection contains about 1000 specimens, representing over 130 species. This is far the largest collection that has been made, or reported from these islands. There is not a tree or bush on the islands, the highest woody plant being the dwarf Salix reticulata. Some critical notes are furnished by Mr. J. N. Rose, and various groups have been referred to well-known specialists.

NOTES AND NEWS.

MR. THEO. HOLM has resigned his position in the National Museum and accepted a place in the Division of Vegetable Pathology.

THE SUMMER course for the study of shrubs and trees at the Arnold Arboretum proved highly successful. About thirty persons were in attendance.

PROFESSOR DR. ALEXANDER BATALIN has been appointed Director of the Imperial Botanic Gardens at St. Petersburg in succession to the late Dr. E. Regel.

---

[1] The Rural Library, vol. 1, no. 6, April, 1892.

[2] Proc. Biol. Soc. of Washington, VIII, 133-150, July, 1892.

THE CHEMICAL COMPOSITION of the pollen of Pinus sylvestris has been investigated by K. Kresling (*Archiv. Pharm.*), and is found to be wonderfully complex. Some thirty or forty complex compounds are listed, and their interpretation is at present out of question.

THE APPROPRIATION for special botanical work in the Botanical Division of the Department of Agriculture has been reduced from $40,000 to $25,000. This is unfortunate in view of the fact that the division had begun a systematic exploration of our least known regions, and the results of the next few years promised to be very great.

A PROPOS of the reference to the great number of novelties among the hepatics described by Colenso (this journal, p. 219, *ante*) should be mentioned a paper by Stephani in the Journal of the Linnean Society, no. 201. After examination of the authentic specimens of 149 species sent to Kew by Colenso, Mr. Stephani concludes that 22 are good species, while 117 are reduced to synonyms!

TWO IMPORTANT contributions to our knowledge of buds have recently appeared; one, by Dr. J. Grüss, in Pringsheim's *Jahrbücher für wissenschaftliche Botanik* XXIII. pp. 637–703; the other by W. Russell in the *Annales des Sciences Naturelles* (botanique) VII. xv. pp. 95—202. Dr. Grüss treats chiefly the anatomy, development, functions and adaptations of the scales of winter buds of trees; Mr. Russell discusses the origin and development of multiple growing points. The latter concludes that the law of the unity of the axillary bud has no exceptions. The accessory buds arise later from the single axillary growing point.

A NOMENCLATOR BRYOLOGICUS, after the plan of Steudel's *Nomenclator botanicus* with the addition of bibliographical references, was undertaken in 1864 by M. le général Paris, at the suggestion of his friend, Dr. W. P. Schimper. For various reasons the work was delayed. He now proposes to take up this work again, and appeals to bryologists to send copies of their papers containing descriptions of new species, or at least references to the place of publication that he may consult them. The work will be of great value to bryologists, and it is to be hoped that it will be vigorously prosecuted and published within a reasonable time. The author may be addressed at Rennes, France.

DRS. ASCHERSON, Engler, Schumann and Urban, of Berlin, seeing the necessity of some modification of the laws of botanical nomenclature formulated in 1867, in order to prevent the confusion likely to be caused by Kuntze's Revisio generum, have proposed the following amendments, which refer only to genera:

"I. The starting point of the priority of the genera, as well as the species, is the year 1752, resp. 1753.

"II. Nomina nuda and seminuda are to be rejected. Pictures alone, without diagnoses, do not claim any priority of a genus.

"III. Similar names are to be conserved, if they differ by ever so little in the last syllable; if they only differ in the mode of spelling the newer one must fall.

"IV. The names of the following larger or universally known genera are to be conserved, though, after the strictest rules of priority, they must be rejected; in many of them the change of the names now used is by no means sufficiently proved."

Regarding the last, they remark:

"The impulse that led to the acknowledgement of the right of priority was only the vivid desire to create a stable nomenclature. If we see that by the absolute and unlimited observance of the principle we probably gain the contrary of what we intended, we, who have ourselves made the rules of priority as a law, have the right to amend the latter." They, therefore, propose to retain seventy-eight genera, embracing nearly 5000 species, in spite of the fact that there are possibly equivalent earlier names. A circular letter containing these proposals is being sent to botanists engaged in descriptive work, with a request that they indicate their adherence to those propositions, or suggest any modifications they desire.

MR. SPENCER LEM. MOORE, in a supplementary paper[1] to the one noticed in this journal, *ante*, p. 102, corrects some of the statements made therein. His conclusion that the callus which closes the sieve plates of the vegetable marrow was of proteid nature, was due to working with abnormal material. "Some of the plates are obliterated by true callus, which neither gives proteid reactions nor peptonizes; others, at the end of the season, are blocked by the proteid body described in the former memoir." For the latter substance he proposes the name "paracallus."

He has also studied the reactions of the cell walls, which are supposed to show that these have enclosed proteid matters in the course of their growth. He concludes that these reactions are not due to proteids, at least not to peptonizing proteids, but probably depend upon glucosides, a point which can sometimes be proved. He suggests that "the presence of glucoside in lignified cell walls may possibly give to them their property of conducting fluid, *à propos* of Haberlandt's discovery of a glucoside as the osmotically active substance in Mimosa pudica."

[1] Journal of the Linnean Society, XXIX, p 231

BOTANICAL GAZETTE

SEPTEMBER, 1892.

Flowers and insects. IX.

CHARLES ROBERTSON.

HYDRANGEA ARBORESCENS L.[1]—The stems rise from one to several feet high and bear flat-topped compound cymes measuring seven to ten centimeters across. Each cyme is commonly surrounded by a few large sterile flowers which render it much more conspicuous. These sterile flowers are remarkably persistent, retaining their form throughout the winter, though they lose their color.

The entire fertile flower with its pedicel is white. The petals are small and soon fall. The stamens, which are commonly ten, with their large anthers, are the most conspicuous part of the flower. When dehiscent they far overtop the stigmas. Nectar is secreted on the base of the styles, though pollen is the chief attraction.

The flowers are homogamous, but are visited by so many bees and flies that frequent cross-pollination is inevitable. Insects may also effect self-pollination, or spontaneous self-pollination may occur by the pollen falling upon the stigmas.

The plants are common on creek banks and were observed in bloom from June 24th to July 23rd. The following list of visitors was observed June 27th and 30th:

Hymenoptera—*Apidæ:* (1) Bombus separatus Cr. ☿, c. p., ab.; (2) B. americanorum F. ♀, c. p.; (3) Ceratina dupla Say ♀, s. and c. p.; (4) Heriades carinatum Cr. ♀, c. p.; *Andrenidæ:* (5) Augochlora labrosa Say ♀, s. and c. p.; (6) Halictus pectoralis Sm. ♂♀, s. and c. p.; (7) H. similis Sm. ♀, s. and c. p.; (8) H. truncatus Rob. (MS.) ♀, s. and c. p.; (9) H. fasciatus Nyl. ♀, c. p.; (10) H. confusus Sm. ♀, s. and c. p.; ab.; (11) H. stultus Cr. ♀, s. and c. p., ab.; (12) Prosopis affinis Sm. ♂♀, s. and f. p., ab.; *Crabronidæ:* (13) Crabro interruptus Lep., s.

[1]See Meehan: Contributions to the life histories of plants, No. II, Proc. Acad. Nat. Sci., Phil., 1888.

Diptera—*Empidæ:* (14) Empis clausa Rob. (MS.) s., ab.; *Conopidæ:* (15) Oncomyia loraria Lw., s., freq.; (16) Stylogaster biannulata Say, s.; *Syrphidæ:* (17) Paragus tibialis Fll., s. and f. p.; (18) Syrphus americanus Wd., s. and f. p.; (19) Allograpta obliqua Say, s. and f. p.; (20) Mesograpta geminata Say, s. and f. p.; (21) Sphaerophoria cylindrica Say, s. and f. p.; (22) Eristalis tenax L., s.; (23) Syritta pipiens L., s. and f. p.; *Tachinidæ:* (24) Jurinia apicifera Wlk., s.; *Muscidæ:* (25) Graphomyia sp., s.; (26) Musca domestica L., s.; (27) Lucilia cornicina F., s.

Coleoptera—*Cerambycidæ:* (28) Euderces picipes F., s. and f. p.; (29) Typocerus velutinus Oliv., s. and f. p.; *Mordellidæ:* (30) Mordella marginata Melsh., s., ab.; (31) Mordellistena sp., s., ab.; (32) M. ornata Melsh.

Lepidoptera—*Hesperidæ:* (33) Eudamus tityrus F., s.; *Pyromorphidae:* (34) Harrisina americana Harr., s. (determined by Prof. G. H. French).

PHILADELPHUS GRANDIFLORUS Willd.[2]—This plant occurs in my neighborhood only in cultivation. I have found it visited very abundantly by *Heriades philadelphi* Rob. ♂♀.

RIBES GRACILE Michx.—The Missouri gooseberry is common in woods, blooming from April 15th to May 3d. The bushes are sometimes collected in large clumps, the flowers being abundant enough to fully repay the attention of insects.

The greenish flowers grow in axillary clusters of two or three. The pendulous position and the characters of the flower indicate an adaptation to bees. The calyx tube is two or three mm. long. The oblong lobes, which measure six or seven mm. in length, are strongly reflexed. With the petals they form footholds for the bees to cling to, and with their purplish bases, are the most conspicuous parts of the flower. The five stamens are exserted 12 mm. or more beyond the calyx-tube, and are closely approximated. Five pinkish petals about 2 mm. long are pressed against the filaments, closing as far as they go the intervals between them.

The flowers are proterandrous. When receptive, the stigma surpasses the anthers a little. The anthers sometimes retain pollen after the stigma becomes receptive, but self-pollination is hardly possible, unless it is brought about by insect aid. Everything points to cross-pollination between separate flowers.

---

[2]On P. coronarius see Müller: Fertilization of Flowers, 248.

The nectar is secreted by an epigynous disk and is held in place by the abundant hairs on the base of the style and on the wall of the calyx-tube. To reach it bees must insert their proboscides between the filaments beyond the tips of the petals. For this purpose a proboscis at least 4 mm. long seems to be needed.

The flowers are especially adapted to bumblebee females, the only sex of Bombus flying while the flowers are in bloom. These bees are the only ones which, while sucking, invariably touch the anthers and stigmas. They cling to the petals and sepals, and the anthers and stigmas strike them about the base of the ventral surface of the abdomen. Of these the following were noted visiting the flowers for nectar:

(1) Bombus separatus Cr. ♀; (2) B. vagans Sm. ♀; (3) B. virginicus Oliv. ♀, ab.; (4) B. americanorum F. ♀, very ab.

Besides bumblebees there occur as frequent visitors a number of species of bees which insert their proboscides between the filaments and are able to reach the nectar, but are so small that they never, or rarely, touch the anthers and stigmas, and so are to be regarded as mere intruders. Such are:

Apidæ: (1) Apis mellifica L. ☿, s. and c. p., ab.; (2) Osmia albiventris Cr. ♂, s.; (3) O. lignaria Say ♂, s.; (4) Nomada luteola Lep. ♂♀, s.; *Andrenidæ:* (5) Agapostemon radiatus Say ♀, s.; (6) Augochlora pura Say ♀, s.; (7) A. lucidula Sm. ♀, s.; (8) Andrena sayi Rob. ♂♀, s., ab.; (9) A. pruni Rob. ♂♀, s.; (10) A. rugosa Rob. ♂, s.; (11) Halictus gracilis Rob. ♀, f. p., ab.; (12) H. coriaceus Sm. ♀, s.; (13) H. lerouxii Lep. ♀, s. and f. p.; (14) H. cressonii Rob. ♀; (15) H. zephyrus Sm. ♀; (16) H. imitatus Sm. ♀; (17) H. stultus Cr. ♀; (18) Colletes inaequalis Say ♂♀, s.

Diptera—*Empidæ:* (19) Empis sp., s.

The visitors were observed on nine days between April 18th and 29th.

LUDWIGIA ALTERNIFOLIA L.—The yellow flowers are rather conspicuous. Honey collects in round drops in four pits on the sides of the ovary between the bases of the filaments. The pits are slightly protected above by a fringe of hairs. Some of the anthers dehisce when fairly in contact with the stigma, but much of the stigma remains clear, and so can receive pollen brought by insects. *Bombus americanorum* F. ☿, was seen visiting the flowers for nectar, and *Halictus stultus* Cr. ♀, visiting them for pollen. The flowers were seen in bloom from July 19th to Aug. 10th.

LUDWIGIA POLYCARPA S. & P.—The flowers are wholly devoid of entomophilous characters. The petals are wanting, and there is no nectar. The four stamens bend inwards, bringing the anthers in contact with the stigma. Spontaneous self-pollination is therefore a regular occurrence.

ŒNOTHERA BIENNIS L.[8]—The following list was observed on Aug. 26th and 29th:

Apidæ: (1) Bombus americanorum F. ♂ ☿, s. and c. p., freq.; (2) Melissodes bimaculata Lep. ♀, c. p.; (3) M. obliqua Say ♀, c. p.

Trochilidæ: (4) Trochilus colubris L., s., two.

I have found the flowers in bloom from July 22nd to Oct. 15th.

Müller found it visited by one Macroglossa, three Bombus, one Apis, one Colletes, one Panurgus, three Eristalis.

ŒNOTHERA FRUTICOSA L.—This is a common plant, growing on prairies. The stem rises a few dm. and generally bears one, sometimes two or three, yellow flowers which expand 4 or 5 cm. Eight large versatile anthers supply pollen, which is an attractive character of the flower. The stigma surpasses the anthers so that self-pollination is impossible without insect aid. As a rule, the stigma is inclined to the lower side in such a position that it readily strikes the ventral surface of a bumble-bee settling upon the flower. If insects come with pollen, they may effect cross-pollination, otherwise they may effect self-pollination. When two or more flowers are expanded at the same time cross-pollination between flowers of the same plant may occur. In the usual case in which the stem exposes only one open flower at a time cross-pollination between distinct plants is the rule.

The tube measures 14–20 mm., so that it can only be drained by the largest bees, but shorter-tongued bees are sometimes able to reach a little of the nectar which rises in the tube.

Besides the long-tongued insects which visit the flower for nectar, there are many species, especially Andrenidae and Syrphidae, which come only for pollen. Accordingly the flower must be regarded as adapted to both sets of insects.

The flowers bloom from May 24th to June 29th. On 7 days, between May 28th and June 19th, the following list was observed:

---

[8]See Müller: Fertilization of Flowers, 246.

Hymenoptera—*Apidæ:* (1) Bombus americanorum F. ♀, s. and c. p., ab.; (2) Synhalonia speciosa Cr. ♀, s. and c. p.; (3) Ceratina dupla Say ♀, c. p.; (4) Megachile brevis Say ♂♀, s.; (5) M. montivaga Cr. ♂♀, s. and c. p., ab.; (6) Alcidamea producta Cr. ♀, c. p.; *Andrenidæ:* (7) Agapostemon nigricornis F. ♀, c. p., ab.; (8) Augochlora pura Say ♀, c. p., freq.; (9) Halictus pectoralis Sm. ♀, c. p.; (10) H. parallelus Say ♀, c. p.; (11) H. lerouxii Lep. ♀, c. p.; (12) H. ligatus Say ♀, c. p.; (13) H. fasciatus Nyl. ♀, c. p.; (14) H. albipennis Rob. ♀, c. p.; (15) H. confusus Sm. ♀, c. p.

Diptera—*Syrphidæ:* (16) Syrphus americanus Wd., f. p.; (17) Sphaerophoria cylindrica Say, f. p.; (18) Eristalis dimidiatus Wd., f. p.; (19) E. latifrons Lw., f. p.; (20) Tropidia mamillata Lw., f. p.; *Tachinidæ:* (21) Cistogaster pallasii Twns., f. p.

Lepidoptera—*Rhopalocera:* (22) Pieris protodice B.-L.; (23) Pamphila peckius Kby.; (24) P. cernes B.-L.—all s.

Coleoptera—*Chrysomelidæ:* (25) Diabrotica 12-punctata Oliv., f. p.; *Curculionidæ:* (26) Centrinus scutellum album Say, f. p., ab.

Gaura biennis L.[4]—This common species was observed in bloom from August 4th to October 24th. The stems grow one or two metres high, bear numerous flowers, and are often collected in large patches.

The flowers are white. The four petals are all turned to the upper side of the flower, and the stamens, which are directed horizontally, afford a landing place to the visiting insects. The stigma is in advance of the anthers and touches the bee before them. The calyx tube is about 10 mm. long. The flowers are adapted to long-tongued bees, but on account of the exposure of the anthers are also visited for pollen by other insects. The list was observed on 5 days, between Aug. 23d and Sept. 10th.

Hymenoptera—*Apidæ:* (1) Apis mellifica L. ☿, c. p.; (2) Bombus americanorum F. ☿, s. and c. p., ab.; (3) B. virginicus Oliv. ☿, c. p.; (4) Melissodes bimaculata Lep. ♀, s. and c. p.; *Andrenidæ:* (5) Halictus confusus Sm. ♀, c. p.

Diptera—*Syrphidæ:* (6) Syrphus americanus Wd., f. p.

Circæa lutetiana L.—The flower is described and figured by Müller in the Fertilization of Flowers, 265. Müller saw

[4]See Sprengel, 223, Pl XIII, 12, 14, 15. See G Lindheimeri, Goodale & Sprague: Wild flowers, Pl XXIII.

the flowers visited by: *Syrphidæ:* (1) Baccha elongata F.; (2) Ascia podagrica F.; (3) Melanostoma mellina L.; *Muscidæ:* (4) Musca domestica L.; (5) Anthomyia sp.

July 2nd, 4th and 10th I saw the flowers visited by:

Hymenoptera—*Andrenidæ* (1) Augochlora pura Say ♀, s. and c. p., freq.; (2) Halictus 4-maculatus Rob. ♂ ♀, s. and c. p., ab.; (3) H. confusus Sm. ♀, s. and c. p.; (4) H. pectinatus Rob. ♀, c. p.; *Chalcididæ:* (5) Spilochalcis debilis Say, s.

Diptera—*Bombylidæ:* (6) sp.; (7) Hemipenthes sinuosa Wd., f. p.; *Syrphidæ:* (8) Allograpta obliqua Say; (9) Mesograpta marginata Say; (10) M. geminata Say—all sucking.

MOLLUGO VERTICILLATA L.[5]—"An immigrant from farther south."—The plants are much branched, the branches lying flat on the ground and bearing small, white flowers, which are numerous but not enough to form conspicuous clusters.

The flowers are erect, expand horizontally and measure about 4 mm. across. The three anthers rise to the level of the three stigmas and alternate with them.

In case of insect visits, cross-pollination between flowers of the same or of distinct plants may readily occur. In case insects fail, spontaneous self-pollination may take place by the anthers coming in contact with the stigmas.

Although the flowers are very inconspicuous, they are attractive to numerous small insects, mainly *Halictus*, on account of their easily accessible nectar.

I have found the plant in bloom from July 1st to Oct. 12th. On three days, July 16th, and Aug. 11th and 21st, the following list of visitors was observed:

Hymenoptera—*Andrenidæ:* (1) Halictus fasciatus Nyl. ♂, s.; (2) H. pilosus Sm. ♂, s.; (3) H. confusus Sm. ♂ ♀, s. and c. p. freq.; (4) H. tegularis Rob. ♂ ♀, s.; (5) H. stultus Cr. ♀, s. and c. p. freq.; *Philanthidæ:* (6) Cerceris finitima Cr., s., freq.

Diptera—*Conopidæ:* (7) Zodion nanellum Lw.; *Syrphidæ:* (8) Paragus tibialis Fll.; (9) Pipiza pulchella Will.; (10) Mesograpta marginata Say; *Sarcophagidæ:* (11) Sarcophaga sp.; *Muscidæ:* (12) Lucilia cornicina F.—all sucking.

Coleopetra—*Malachidæ:* (13) Collops 4-maculatus F., s.

SAMBUCUS CANADENSIS L.—The stems grow three or four meters high, and are commonly collected in clumps, which at blooming time are fairly white with the large flat-topped cymes. The flowers expand 4 or 5 mm. They are homo-

[5]On this plant see Meehan; Torrey Bulletin, XIV, 218.

gamous. The stamens are so strongly divergent that spontaneous self-pollination is impossible. Nectar is wanting, the object of insect visits being the pollen. The plant is common and was observed in bloom from June 15th to July 25th. June 17th, 23d and 24th, the following visitors were noted:

Hymenoptera—*Apidæ:* (1) Apis mellifica L. ☿, freq., (2) Ceratina dupla Say ♀; *Andrenidæ:* (3) Halictus zephyrus Sm. ♀, ab.; (4) H. confusus Sm. ♀, ab.; (5) H. stultus Cr. ♀, ab.—all collecting pollen.

Diptera—*Bombylidæ:* (6) sp.; (7) Hemipenthes sinuosa Wd.; *Syrphidæ:* (8) Chrysogaster nitida Wd., ab.; (9) Syrphus ribesii L., freq.; (10) Allograpta obliqua Say, freq.; (11) Mesograpta marginata Say; (12) Eristalis dimidiatus Wd.; *Muscidæ:* (13) Lucilia cornicina F.; *Anthomyidæ:* (14, 15) Chortophila spp.—all feeding on pollen.

Coleoptera—*Dermestidæ:* (16) Attagenus piceus Oliv.; *Malachidæ:* (17) Anthocomus erichsoni Lec.; *Cerambycidæ:* (18) Euderces picipes F.; *Mordellidæ:* (19) Pentaria trifasciata Melsh.—all feeding on pollen.

HOUSTONIA PURPUREA L., VAR. CALYCOSA Gr.—This common plant grows in tufts or clusters which are rendered quite conspicuous by the abundant white flowers, the stems rising about 2 dm.

The corolla is funnel-form, measuring about 8 mm. in length, its border also expanding about 8 mm. The tube is about 7 mm. Below it is narrowed for about 4 mm. Small bees can insert their heads as far as 3 mm., when they need a proboscis 4 mm. to drain the sweets. The narrow part of the tube is obstructed in both forms by abundant hairs, in the long-styled form by the anthers and in the short-styled form by the stigma. The anthers of the short-styled form are in the angles of the mouth of the tube, the stigma of the long-styled form being more strongly exserted.

The anthers of the long-styled form apply their pollen to the proboscides of the visitors. The anthers of the short-styled form dust their pollen indefinitely upon all parts of the insects. Accordingly the long-styled form has a larger stigma.

The flowers are adapted to small bees, like *Ceratina*, *Calliopsis* and *Halictus*, but are also visited by flies, beetles and butterflies. Butterflies, however, are only adapted to pollinate the short-styled form, since they can suck this form with-

out touching the anthers. A monopoly of the flowers by them would probably result in a functional diœcism, characterized by long-styled staminate and short-styled pistillate flowers.

The plant blooms from May 19th to June 30th. The list was observed on 6 days, between May 25th and June 12th.

Hymenoptera—*Apidæ:* (1) Apis mellifica L. ☿, s.; (2) Synhalonia honesta Cr. ♂, s.; (3) Ceratina dupla Say ♂♀, s. and c. p., ab.; (4) Heriades carinatum Cr. ♂ s.; (5) Calliopsis andreniformis Sm. ♂♀, s. and c. p., ab.; *Andrenidæ:* (6) Augochlora pura Say ♀, s. and c. p.; (7) Halictus ligatus Say, ♀, s.; (8) H. pilosus Sm. ♀, s. and c. p.; (9) H. confusus Sm. ♀, s. and c. p.; (10) H. albipennis Rob. ♀, s. and c. p.

Diptera—*Syrphidæ:* (11) Paragus bicolor F., s.; (12) P. tibialis Fll., s.; (13) Mesograpta marginata Say, s.; (14) Sphaerophoria cylindrica Say, s. and f. p., ab.; (15) Syritta pipiens L., s.

Lepidoptera—*Rhopalocera:* (16) Pieris protodice B.-L.; (17) Chryophanus thoe B.-L.; (18) Ancyloxypha numitor F., ab.; (19) Pholisora catullus F. —all sucking.

Coleoptera—*Scarabæidæ:* (20) Trichius piger F., s., ab.; *Curculionidæ:* (21) Centrinus scutellum-album Say, s.; (22) Stethobaris sp., s.

Carlinville, Ill.

Botanical papers read before Section F, A. A. A. S., Rochester meeting.

N. L. BRITTON: "*Notes on Ranunculus repens and its eastern North American allies.*"—Attention was called to the group relationship that evidently exists between the European R. repens and such American species as *R. hispidus* Mx., *R. fascicularis* Muhl., *R. septentrionalis* Poir., *R. palustris* Ell. (a somewhat doubtful southern species), and the British Columbian *R. Macounii* Britton. Illustrated by specimens.

N. L. BRITTON: "*Notes on a monograph of the North American species of Lespedeza.*"—The author believes that it would facilitate the study of these species to recognize a greater number of species than heretofore, instead of considering some of them forms. Illustrated by numerous specimens.

W. W. ROWLEE: "*The root-system of Mikania scandens.*"—Mikania develops a great number of roots under water which never reach the soil. The greatest development of these is

during and after anthesis, in autumn, when the root-branching is immense. These roots come to the surface and either float or rise above it. If the water rises above them they grow longer. When transplanted to dry conditions the same root-system is developed. The rootlets, however, are not so long, but stop just above the surface of the ground, forming multitudes of little "knees" about an inch or less in height. A peculiar anatomical structure is found in the presence (in section) of four peculiarly modified cells, two of which belong to the endodermis and two to the row of cells just outside. These cells always lie in contact with the phloem cells and are so arranged as to enclose a rectangular intercellular space of considerable size and definite shape. They have large nuclei which are always upon the side of the cell next to the intercellular space. These spaces extend to very near the growing point of the root, thus forming long tubes. This, taken in connection with the peculiar development of the roots and their place of growth, is strong evidence in favor of their performing the function of aeration.

L. M. UNDERWOOD: "*Preliminary comparison of the hepatic flora of boreal and sub-boreal regions.*"—To be published in full in the GAZETTE.

E. F. SMITH: "*On the value of wood-ashes in the treatment of peach-yellows.*"—This well-known treatment had been fully tested, and was found inefficient in all doses. The conclusion was that peach-yellows cannot be cured or prevented by wood-ashes.

E. F. SMITH: "*On the value of superphosphates and muriate of potash in the treatment of peach-yellows.*"—This mixture is that recommended by Profs. Goessmann and Penhallow. It was tested for three years, 1889-1891, and no benefit was discovered. In fact, the treatment seemed rather to favor the disease than otherwise. It was remarked that well-fed plants may become diseased quite as readily as weak plants.

G. MACLOSKIE: "*Notes on maize.*"

W. J. BEAL: "*Spikes of wheat bearing abnormal spikelets.*"—Spikes of Missouri wheat, Champion Amber, Early Red Clawson, and several others, bear spikelets either rudimentary or perfect near those normally appearing. These are much like reduced forms of miracle or Egyptian wheat, in which the spikes are branched. Illustrated by specimens.

W. J. BEAL: "*A study of the relative lengths of the sheaths and internodes of grasses for the purpose of determining to*

what extent this is a reliable specific character."—Some agrostologists use this character and some do not. From 10 to 30 plants in each of 47 species were examined, and the internodes and sheaths measured and tabulated. The character proved good in 35 species. In very variable species it is of less importance, and in no case would it be safe to rely upon one or two stems alone. The sheaths and internodes of very tall specimens or very short ones are usually much less reliable for specific characters than those of medium height. The second and third sheaths and internodes from the top are more reliable for this purpose than the others. Illustrated by seven charts.

W. W. ROWLEE: "*Adaptation of seeds to facilitate germination.*"—The most critical time in the life history of the plant is when the embryo is dormant in the seed. Hence it is to be expected that all modifications of the seed have some explanation in the economy of its existence. Careful observation of the germination of seeds of native plants shows that few seedlings are produced. Fruits of Acer dasycarpum are held upright by the wing when falling in grass or rubbish. Planting seeds below the surface of the ground showed that twice as many seeds grew when planted with radicle down as with radicle up. The paper was followed by an interesting discussion concerning the struggle for existence and the vitality of seeds.

H. L. RUSSELL: "*Bacteriological investigations of marine waters and the sea floor.*"—To be published in full in the GAZETTE.

F. V. COVILLE: "*Sketch of the flora of Death Valley, California.*"—The paper was introduced by a general statement of the topography of Death Valley. The absence of trees was spoken of and the characteristics of other vegetation. Lists of species were arranged by groups, with an account of the special adaptation of species to desert conditions. In conclusion the geographical relationship of the flora was discussed.

J. C. ARTHUR: "*How the application of hot water to seed increases the yield.*"—To be published in full in the GAZETTE.

M. MILES: "*Heredity of acquired characters.*"—Weismann's theory of the continuity of a stable, immortal germ-plasm that is independent of the body-plasm, and transmitted without change from one generation to another, is not warranted by the known facts of physiology, and it cannot,

therefore, be accepted as proof that acquired characters are not hereditable. The transformations of matter and energy in the metabolic processes of nutrition, in plants and animals, as now interpreted by physiologists, must extend to the growth and development of the germ-cells, which are thus brought into intimate relations with the metabolism of every part of the body. The general course and results of the processes of nutrition are essentially the same in plants and animals. The food constituents, in the first place, are built up into protoplasm, with a storing of energy as an indispensable condition of its constitution; and the various tissues and constituents of the organism, including the germ-cells, are then formed as products of its destructive metabolism, with a liberation of a portion of the stored energy in the form of heat. Established habits of the system, or of particular organs, and changes in the environment including conditions of food-supply, have an influence on the general and special processes of metabolism of the system, in which the germ-cells are involved, and the hereditary transmission of the modified habits of the organism are thus provided for. The non-appearance of any peculiarity of the parent in the next generation cannot be accepted as evidence that it has not been transmitted, as it may be obscured and made latent through the dominant influence of other characters, as in the well known facts of atavism. Morphological characters are not more important factors in evolution than the functional activities and bias of the organism on which they depend for their origin and development. The transmission of a morphological character must consist in a transmitted functional activity of the organism that determines the development of the morphological peculiarity under favorable conditions for its exercise. In addition to these physiological considerations, evidence of the heredity of acquired characters was presented in the results of direct experiment, and observations in the breeding and improvement of domestic animals.

L. H. BAILEY: "*On the supposed correlation of quality in fruits--a study in evolution.*"—It is commonly supposed that as quality in cultivated fruits increases various other characters, as size, color, and vigor of plant, decrease. The question is a philosophical one, for its answer must determine whether cultivated plants are subject to the same laws of variation as their wild congeners, whether all characters vary independently, or whether cultivation introduces some

new law of progression in parallelisms. The subject is approached by a study of the scales of points used in the best fruit-lists, by which it becomes apparent that all desirable qualities often appear in the same variety of fruit, and that many of our best market-fruits are also best for the dessert. The best records show that diminished size, low color, comparative seedlessness, tenderness of tree, and lessened vigor, are not correlated with high flavor. It is also shown that there is no loss of sweetness or aroma in domesticated fruits which is due to cultivation and amelioration. It is evident from the whole discussion that quality and other characters of cultivated fruits appear independently of each other, that there is no correlation between these characters. There is general increase in all characters as amelioration progresses, at least in all characters which are particularly sought by horticulturists; and this fact must ever remain the chief inspiration to man in the amelioration of plants.

H. L. RUSSELL: "*Non-parasitic bacteria in vegetable tissue.*" —Experiments were made by infecting healthy plants with various species of bacteria, saprophytic as well as those that are pathogenic for animals, to see (1) the effect of any of these micro-organisms upon the plant, and (2) the reciprocal effect of the host upon the micro-organism. The conclusions reached were that healthy plant-tissues, like animal tissues, are normally free from bacteria; but that, unlike the animal tissue, many micro-organisms are able not only to exist within the tissues of plants, but possibly possess some powers of multiplication.

W. A. KELLERMAN: "*Note on yellow pitch pine.*"—A well marked form of pitch pine was recently found in Fairfield county, Ohio, which may be characterized as *P. rigida* var. *lutea* Kellerman. It differs in the thinner scarcely furrowed reddish-yellow bark, and in the deeper yellow more durable and more distinctly marked heartwood. It occurs with the species, yet appears quite distinct. The form is easily recognized by sight, and is not a mere lumberman's questionable distinction.

W. A. KELLERMAN: "*Germination at intervals of seed treated with fungicides.*"—Experiments in connection with a study of fungicides for smut of oats have shown that seed treated with hot water and solutions of potassic sulphide germinate more quickly than untreated seed. Dr. Arthur has also shown that such treated seeds would continue to

germinate more quickly after a considerable period of time had elapsed. Experiments touching this were instituted, with the following results: (1) That germination of treated seed is more rapid than of untreated seed immediately after treatment; (2) that this action continuously declines with time and the germination is ultimately less rapid and inferior.

M. B. WAITE: "*The fertilization of pear flowers.*"—A brief general account was given of a large series of experiments on the fertilization of pear flowers. Abundant insect visitors were noted and the effect on them of climatic conditions. The general conclusions were: (1) Some cultivated varieties of pear are capable of self-fertilization, but the majority are not; (2) cross-fertilization is effected by insects; (3) cross-fertilization, at least the kind required for the setting of fruits, consists in crossing one horticultural variety with another, and not in crossing one tree of a certain variety with another of the same name.

C. V. RILEY: "*The fertilization of the fig and caprification.*' —A résumé of the subject of caprification in the older countries was given, showing its importance and necessity in the cultivation of the best Smyrna figs, with a statement of the differences between the Smyrna and Adriatic figs. The author considered the question of the importation of *Blastophaga psenes* for the fig-growers of California, and pointed out how it could be successfully done. He touched on the erroneous notions that have been published on the subject, and finally considered the caprifig insects associated with the wild figs of North America, characterizing some fourteen of them from Florida, Mexico and St. Vincent.

F. B. MAXWELL: "*A comparative study of the roots of Ranunculaceæ.*"—The paper contained the results of the examination of the roots of about thirty species native to the northern United States, including a comparative study of the apical meristem and of the changes taking place through secondary growth. Authorities on meristem structure have assigned the roots of this order to a single type; while the author finds two principal types, each including a considerable number of species. It is usually assumed that secondary changes take place to a greater or less extent in mature roots of dicotyledons; but the author finds in many Ranunculaceæ that the primary structure persists in the older roots. On the basis of changes taking place through secondary growth, the author made three classes for the roots studied.

O. F. COOK: "*Do termites cultivate fungi?*"—In the nests of Liberian species of Termes are found honeycombed masses of a punk-like substance, irregularly rounded in general shape. Over all the surfaces and passages of this material there grows the mycelium of a mucor-like fungus, having white sporangia about 5 mm. in diameter. The young termites apparently feed upon these fungi. A similar condition of things obtains with another species of Termes living underground.

JAMES H STOLLER: "*The conditions which determine the distribution of bacteria in the water of rivers.*"—In the author's absence the paper was read by title.

WILLIAM P. WILSON: "*Adaptations of plants to environment.*"—A comparison of lowland vegetation near the sea with that of desert and mountain areas. A large number of lantern slides were shown, illustrating the ways in which plants of these regions protect themselves against excessive evaporation, particularly by change in position of foliage. In such leaves the author found no change in the position of the chlorophyll bodies. The stomata in the exposed leaves were closed, while those in shaded leaves were open.

S. A. BEACH: "*Notes on self-pollination of the grape.*"—The author showed that the proper time for examining grape-buds to determine whether self-pollination occurs before the flowers open is just at the time when dehiscence of the calyx begins. Clusters of grapes were enclosed in bags before blossoming to prevent the access of foreign pollen. Self-pollination was observed in seventy-seven individuals, distributed among eight species and their hybrids and crosses.

GEO. B. SUDWORTH: "*The comparative influence of odor and color of flowers in attracting insects.*"—Attention was called to a supposed development from a low to a high grade in the colors of flowers, ranging from "the simplest, yellow; 2nd, white; 3d, pink to red; 4th, the most perfect color, blue." The author spoke of his own experiments and those of others, which seem to prove that nectar-gathering insects of higher order (honey bees, etc.) show a preference for the colored flowers of higher grade. He believes, however, that the comparative attractability of color is less powerful in its influence upon insects than that of odor, his experiments showing, first, that the honey bees work persistently upon syrup scented with an artificial sweet odor (anise), but refuse to take the

same sweet when unscented; and second, that color does not attract insects at all when tested equally with an odor, the supply of sweet to be obtained in connection with the color and odor tests being equal in both cases.

CHAS. W. HARGITT: "*Notes on Daucus Carota.*"—In the author's absence the paper was read by title and will be published in full in the GAZETTE.

FREDERICK V. COVILLE: "*Geographical relationship of the flora of the high Sierra Nevada, California.*"—A list of the representative species of the high Sierra Nevada was given, and also a comparison of these plants with those found in the Rocky Mountains and the Cascades. This comparison indicated (1) a large endemic flora of the Sierra Navada, (2) a group of species common to all these ranges; (3) a group of species common only to the Sierras and Cascades; (4) a group common only to the Sierras and Rockies.

W. M. BEAUCHAMP: "*Variation in native ferns.*"

DAVID G. FAIRCHILD: "*Live-for-ever eradicated by a fungous disease.*"—Attention was drawn to a new species of fungus which since 1887 has been in use among the farmers of Cortland Co., N. Y., in the eradication of a most troublesome weed, (Sedum Telephium). A short history of the successful use of this disease was given, with a brief description of the parasitic fungus which causes the destruction of the plants. Attention was called to a new mode of spore-formation connected with the production of the macrospore of this fungus.

GEORGE VASEY: "*Otto Kuntze's changes in the nomenclature of North American grasses.*"—In the author's absence this paper was read by title.

B. E. FERNOW and GEO. B. SUDWORTH: "*Revised nomenclature of the arborescent flora of the United States.*—"The paper points out the practical bearing and importance of the question of nomenclature, and suggests certain principles intended to secure fixity.

C. V. RILEY: "*On Carphoxera ptelearia, the new herbarium pest.*"—In the author's absence the paper was read by title.

FREDERICK V. COVILLE: "*Characteristics and adaptations of desert vegetation.*"—The author spoke of the source and distribution of moisture, its conservation, the temperature, and the seasons. A list of species of the Mohave desert, arranged by groups, was given, with a discussion of general and particular adaptations.

FILIBERT ROTH: "*Shrinkage of wood as observed under the microscope:*"—In the author's absence the paper was read by title.

L. H. PAMMEL: "*Peziza sclerotiorum;*" and "*Temperature and some of its relations to plant life.*"—In the author's absence these two papers were read by title.

BYRON D. HALSTED: "*Pleospora of Tropæolum majus.*" A fungus of the Alternaria type was found upon the foliage of a garden nasturtium, associated with the perithecia of a Pleospora. Cultures upon slant agar tubes were made of the Alternaria spores and a pure growth of the black mould obtained, followed by the ascigerous form *in* and not upon the surface of the agar. The perithecia were of many and strange shapes, not at all resembling those of the leaves except in the cellular structure of the wall and the size and shape of the spores. This was an unusual instance of the direct modifying effect of the surrounding media upon the size and form of the perithecia. The species is apparently new and may be called *Pleospora Tropæoli.*

BYRON D. HALSTED: "*Secondary spores of anthracnoses.*" —A study of the germinating spores of species of anthracnose shows that the formation of "special cells" or "secondary spores" is probably confined to two genera, viz: Glœosporium and Colletotrichum. They seem to be constantly present in these two genera. Those conditions which are not especially favorable for the production of ordinary spores are well adapted to the formation of secondary ones. There is some uniformity in the color and shape of the special cells, but more in the position they occupy upon the filament. The nature of these cells is not easily determined. They seem to be bodies for enduring periods unfavorable for the growth of the fungus. These cells sometimes increase in number and form a sclerotium, as is well known among some other fungi.

BYRON D. HALSTED: "*A bacterium of Phaseolus.*"—The paper announces the discovery of a new bacterial disease of beans, the species is characterized, and the name Bacterium Phaseolum proposed.

THOMAS MEEHAN: "*The significance of cleistogamy.*"—In the author's absence the paper was read by title.

Proceedings of the Botanical Club of the A. A. A. S.

The first meeting of the Club for the year convened promptly, Thursday, Aug. 18, at 9 A. M. in a room well adapted to the purpose in the main building of Rochester University. An unusually large number of botanists were in attendance. In the absence of both the president, Prof. V. M. Spalding, and the vice-president, Dr. Stanley Coulter, Dr. H. H. Rusby was chosen to preside. The secretary, Mr. D. G. Fairchild, presented his report as treasurer, which was accepted. A contribution from those present, amounting to $4.20, was made to cover the small deficit remaining on the books and to provide for future expenses:

Messrs. Hollick, Barnes and Coville were appointed a committee on nomination of officers for the next meeting. After announcements regarding excursions, a committee on nomenclature was appointed upon motion of Dr. Britton, consisting of Messrs. N. L. Britton, J. M. Coulter, H. H. Rusby, W. A. Kellerman, F. V. Coville, L. M. Underwood and L. F. Ward.

A paper read by Mr. F. V. Coville, mentioned again in the list of papers below, led to the appointment of a committee of three, F. V. Coville, W. J. Beal and B. E. Fernow, to consider the botanical use of the terms *range*, *locality*, *station* and *habitat*. After the reading of papers by Mr. Thos. Morong and Prof. L. M. Underwood, the Club adjourned.

THURSDAY, August 18, 1 P. M.:

Papers were read by Mr. F. B. Maxwell and Mr. W. F. Swingle, both of which led to prolonged discussions, after which the Club adjourned.

FRIDAY, August 19th, 9 A. M.:

The morning session opened with a paper by Mr. Morong upon asclepiadaceous insect traps.

Upon motion of Prof. Beal a vote of thanks was tendered to Dr. E. B. Southwick, botanist of the N. Y. Central Park, for his exhibit of 60 or more species of fruits and nuts, including their branches and leaves, freshly gathered from the park.

The Club has always taken a special interest in the Botanical Division of the U. S. Department of Agriculture, and in accordance with the custom of the Club, the president called upon Dr. Geo. Vasey, the Chief of the Division, to inform

the members in regard to the work now being prosecuted. He said that on account of diminished appropriations the work of the present season is somewhat restricted. The chief field work is in Idaho, by Messrs. Sandberg, Small and MacDougal. Over 53,000 specimens have already been received. The distribution of specimens to agricultural colleges continues. The economic and scientific publications of the Division will continue as heretofore. The third part of the flora of Texas, being prepared by Pres. J. M. Coulter, will be published in a few months. The stations for testing the economic value of native grasses in the arid regions, the first one established four years ago, have been partly abandoned for want of funds. The principal station is at Garden City, Colo., and embraces 160 acres, of which 25 acres are devoted to Bromus inermis, the most successful grass so far tried in the region. Other grasses are also grown in considerable quantities.

Dr. Britton, chairman of the committee, announced that the committee on nomenclature had a unanimous report to submit, which would soon be ready in printed form. It was made the order of business for 1 P. M.

The subject of a World's Congress of botanists next year was brought up by Dr. Arthur, who gave a brief account of the movement to have a congress under the auspices, and forming a part of the general scheme, of the World's Congress Auxiliary, an adjunct organization to the World's Columbian Exposition. A request for an opinion from the committee appointed by the Auxiliary regarding the feasibility of carrying out the plans already outlined, was answered by Dr. Arthur, who said that the committee were not sanguine of success. Dr. Barnes moved "that it is the sense of the Botanical Club of the A. A. A. S. that it is inexpedient to attempt to hold an International Congress in connection with the World's Columbian Exposition in Chicago in the summer of 1893," which was unanimously adopted.[1]

The desirability of emphasizing in some way the next year's gathering of botanists was now brought forward by Dr. Arthur, and a committee of three members of the Club, Messrs.

---

[1] It may be noted in this connection that the Section of Biology, F, subsequently passed the following:

Resolved, That this Section appoint as its committee the outgoing officers of Section F, and the incoming officers of Sections F and G, to confer and co-operate at their discretion with World's Congress Auxiliary.

J. C. Arthur, B. L. Robinson and T. H. McBride, was appointed to report to the Club at a later session in regard to the matter.

The morning session closed with a paper by Mr. O. F. Cook.

FRIDAY, August 19, 1 P. M.:

The committee on nomenclature presented its report in printed form, which was adopted, article by article, with only a few verbal changes, as follows:

Resolved, That the Paris code of 1867 be adopted except where it conflicts with the following recommendations:

I. *The Law of Priority.*—Priority of publication is to be regarded as the fundamental principle of botanical nomenclature.

II. *Beginning of Botanical Nomenclature.*—The botanical nomenclature of both genera and species is to begin with the publication of the first edition of Linnæus' *Species Plantarum*, in 1753.

III. *Stability of Specific Names.*—In the transfer of a species to a genus other than the one under which it was first published the original specific name is to be retained, unless it is identical with the generic name or with a specific name previously used in that genus.

IV. *Homonyms.*—The publication of a generic name or a binomial invalidates the use of the same name for any subsequently published genus or species respectively.

V. *Publication of Genera.*—Publication of a genus consists only (1) in the distribution of a printed description of the genus named; (2) in the publication of the name of the genus and the citation of one or more previously published species as examples or types of the genus, with or without a diagnosis.

VI. *Publication of Species.*—Publication of a species consists only (1) in the distribution of a printed description of the species named, (2) in the publishing of a binomial, with reference to a previously published species as a type

VII. *Similar Generic Names.*—Similar generic names are not to be rejected on account of slight differences, except in the spelling of the same word; for example *Apios* and *Apium* are to be retained, but of *Epidendrum* and *Epidendron*, *Asterocarpus* and *Astrocarpus*, the later is to be rejected.

VIII. *Citation of Authorities.*—In the case of a species which has been transferred from one genus to another the original author must always be cited in parenthesis, followed by the author of the new binomial.

N. L. BRITTON, JOHN M. COULTER, HENRY H. RUSBY, WILLIAM A. KELLERMAN, FREDERICK V. COVILLE, LUCIEN M. UNDERWOOD, LESTER F. WARD,

Committee.

The main discussion upon this report was under article VI in regard to the acceptance of named exsiccati not accompanied by a description as valid publication of a species, which was discussed by Messrs. Beal, Coulter, Vasey, Swingle, Bailey, Kellerman, Barnes, Fernow, Cook, Dudley, Morong, Britton, Underwood and Johnson. The motion to amend by including exsiccati was lost.

Dr. Britton moved that a permanent committee be appointed to serve as a board of arbitration, and to prepare and print a list of the flowering plants within the area of the sixth edition

of Gray's Manual in accordance with the recent report on nomenclature. It was subsequently agreed to extend the range to include Canada, Nebraska and Kansas. On motion of Dr. Arthur, the nomenclature committee was made the permanent committee for this purpose. A further motion was carried "that this committee be empowered to receive all suggestions and criticisms of this list, and to report upon them at the next year's meeting."

MONDAY, August 22d, 9 A. M.:

In absence of the acting president, Dr. H. L. Russell was called to the chair. The committee on nomination of officers for next year reported the names of Dr. W. P. Wilson of the University of Pennsylvania for president, Prof. W . A. Kellerman of the University of Ohio, for vice-president, and Prof. T. H. McBride, of the University of Iowa for secretary. They were elected unamiously.

Papers were then read by Mrs. E. G. Britton, Dr. B. D. Halsted, Mr. F. V. Coville, Dr. N. L. Britton, Dr. J. C. Arthur, and Dr. L. M. Underwood.

The following motion presented by Dr. Britton was approved: "That Dr. Lucien M. Underwoood be delegated to represent this association of American botanists at the International Botanical Congress to be held at Genoa, Italy, Sept. 4–11, 1892."

A committee of three was then appointed to obtain funds by subscription to defray the expenses of the delegate. Drs. J. M. Coulter, W. P. Wilson and E. F. Smith were named such committee.

MONDAY, August 22d, 1:00 P. M.:

The club was called to order with vice-president Wilson in the chair. The committee on plans for the next year's meeting presented a report recommending:

I. (1) That the officers of the section of botany for 1893 (vice-president and secretary) shall, together with one person to be chosen by the Botanical Club, constitute a committee to whom is referred the arrangement of a special program for the meeting of 1893.

(2) That this program shall include among other matters certain special topics selected by the committee.

(3) That each topic shall be introduced by a paper presented by some person to whom the topic has, with his consent, been assigned.

(4) That upon completion of the preliminary program and other arrangements a printed statement with an invitation to be present at the meeting be sent to both American and foreign botanists.

II. That a committee of three, of which Dr. N. L. Britton shall be chairman, be appointed to make such arrangements for special excursions at the close of the meeting as may be found practicable and desirable.

The matter of a new society of botanists, to more fully unify and subserve the botanical interests of the country, was next introduced by Prof. L. H. Bailey. After some discussion, showing a general belief that such a society was desirable, but with some doubts as to the advisability of establishing it at the present time, a committee of nine was appointed "to consider the formation of an American Botanical Society, after obtaining the views of the botanists of America on the proposition, and report thereon at the meeting of the Club next year."

Papers were read by Mrs. E. G. Britton, Mr. A. A. Crozier, Dr. W. P. Wilson and Dr. N. L. Britton.

TUESDAY, AUGUST 23d, 1:30 P. M.:

Acting President Wilson announced the following committees: On program for Madison meeting, Chas. E. Bessey, Frederick V. Coville and Chas. R. Barnes; on botanical excursions at the close of the Madison meeting, N. L. Britton, Wm. Trelease and Douglass H. Campbell; on the establishment of an American Botanical Society, L. H. Bailey, W. G. Farlow, Emily L. Gregory, Byron D. Halsted, James Fletcher, Douglass H. Campbell, Charles R. Barnes, F. Lamson-Scribner and Lester F. Ward. On motion of Dr. Britton the name of W. P. Wilson was added to the last committee.

The committee on the use of certain topographical terms brought to the attention of the Club by Mr. Coville on the first day of the session, reported through its chairman, Mr. B. E. Fernow, that a unanimous decision had not yet been reached. On motion the committee was continued to report at the next year's meeting.

Papers were read by Mrs. Wolcott and Mr. Chas. Mohr.

The Club adjourned to meet at Madison, Wisconsin, in 1893.

COMMENTS.

The attendance upon the meetings of the Club throughout was excellent, quite equaling that of the Section of Biology. Many more papers were listed than could be read for want of time, and others would doubtless have been presented if the authors had seen any probability of gaining a hearing. Never in the history of the Club have so many matters of general interest, which may be grouped under the caption of "business," come before the Club for decision. In fact the time

consumed in transacting business, although conserved to the utmost by the watchfulness of the chair, and the assistance of committees, seriously interfered with the reading of papers, and introduced an element of irregularity and uncertainty into the program that detracted somewhat from the general interest which usually centers upon the hearing of papers and their discussion. Hereafter matters of this class will doubtless largely come before the newly formed Section of Botany.

If the business brought before this meeting was considerable and somewhat burdensome, it is pleasant to reflect that for the most part it sustained more than usually important relations to the general welfare of American botanical science, and that the large number of able and representative men present must go far toward insuring approval of the decisions from other botanists, who had not the privilege of being in attendance. The full list of botanists present can not be given for want of space, but a few may be mentioned, viz: L. H. Bailey, Cornell Univ. N. Y.;W. J. Beal, Mich. Agr. Coll.; N. L. Britton, Columbia Coll., N. Y.; Mrs. E. G. Britton, N. Y.; O. F. Cook, N. Y.; J. M. Coulter, Ind. Univ.; J. C. Arthur, Purdue Univ., Ind.; C. R. Barnes, Univ. of Wis.; F. V. Coville, U. S. Div. of Botany; W. R. Dudley, Leland Stanford Univ., Cal.; D. G. Fairchild, U. S. Div. of Veg. Path.; B. E. Fernow, U. S. Div. of Forestry; B. D. Halsted, N. J. Exper. Station; Arthur Hollick, N. Y.; W. A. Kellerman, Univ. of Ohio; T. H. McBride, Univ. of Iowa; Charles Mohr, Ala.; Thomas Morong, Columbia Coll., N. Y.; B. L. Robinson, Harvard Univ., Mass.; H. H. Rusby, Coll of Pharmacy, N. Y.; H. L. Russell, Univ. of Chicago, Ill.; F. L. Scribner, Univ. of Tenn.; E. F. Smith, U. S. Div. of Veg. Path.; G. B. Sudworth, U. S. Div. of Forestry; W. T. Swingle, U. S. Div. of Veg. Path.; M. B. Thomas, Wabash Coll., Ind.; Wm. Trelease, Mo. Bot. Garden; L. M. Underwood, De Pauw Univ., Ind.; Geo. Vasey, U. S. Div. of Botany; M. B. Waite, U. S. Div. of Veg. Path.; L. F. Ward, Smithsonian Inst., D. C.; and W. P. Wilson, Univ. of Penn.

Papers presented to the Botanical Club of the A. A. A. S.

For the first time in the history of the Club the daily program was printed as part of the daily program of the A. A. A. S., which proved a great convenience. The advantage of knowing what papers were upon the list, however, was largely neutralized by the miscellaneous introduction of business, which took much of the time, and made it impossible for either readers or auditors to judge when a paper would be called. The volume of the business transacted accounts for the comparatively small number of papers read, and the many left unread.

The following papers were read:

AUGUST 18TH, MORNING SESSION.

F. V. COVILLE: *Use of the terms range, locality, station and habitat.*—The confusion in the botanical use of these words was pointed out. A definition of each was submitted and their usage in accordance with the same illustrated. The discussion was participated in by Dr. C. R. Barnes, Dr. N. L. Britton, Mr. W. H. Seaman, Mr. B. E. Fernow, and Dr. Thomas Morong, and in the main supported the views put forth by the author.

THOMAS MORONG: *Travels in Paraguay, and its flora.*—The author prefaced his paper by saying that when in Paraguay he had received the expression of good will and sympathy sent by the Club in session at Toronto in 1889, and he now desired at the first opportunity he had had, to specially thank the Club for its courtesy, and to further show his appreciation he had prepared the present paper, briefly giving an outline of his travels. The author then read a very interesting account of the territory traversed, the perils and interruptions encountered, and especially of the nature of the vegetation. Drs. Rusby and Britton added some information, particularly in regard to the dangers of the trip and its happy termination.

L. M. UNDERWOOD: *A variety of Polypodium vulgare, new to America.*—This much altered form was found on Mohawk Mt., Conn., and was believed to be worthy the rank of a variety. Specimens were shown. The author took the opportunity to exhibit specimens of Onoclea sensibilis, in which the sterile fronds had been destroyed, and the later-appearing fertile fronds had unrolled, taking on a shape intermediate between the usual sterile and fertile fronds, and becoming as-

similatively active. This form, the so-called var. obtusilobata, he believed always to arise from injury to the vegetative fronds of the plant, and to be in no wise due to hybridity.

AUGUST 18TH, AFTERNOON SESSION.

F. B. MAXWELL: *Symbiotic growths in the roots of Ranunculaceæ.*

W. T. SWINGLE: *Some rare and interesting fungi from Florida.*—Specimens were shown and a description of the development, so far as known, was given of new parasites of more than usual interest. An ascomycetous species, in some respects resembling Claviceps, attacked and totally destroyed the inflorescence of Cenchrus tribuloides.

AUGUST 19TH, MORNING SESSION.

THOMAS MORONG: *Observations upon certain species of Asclepiadaceæ as insect traps.*—The conclusion was reached that the parts holding the insect were sensitive, and were brought firmly together by the irritation due to the presence of the insect's proboscis. The author also took the opportunity to exhibit fresh specimens of his Nuphar rubrodiscum, which, upon further study, he still believed to be a good species. If it were to be degraded to a variety, he thought it should go under N. Kalmianum, and not under N. advena, as in the last edition of Gray's Manual.

O. F. COOK: *General notes upon the flora of Liberia.*—The general topography, climate and appearance of the vegetation were described. It is moist and warm the year round, there being no true dry season. Coniferæ are entirely absent. Aquatic plants and mosses are scarce, but hepatics are wonderfully abundant, both in species and individuals. A tree-like lycopod, 8 to 10 feet high, is a common and beautiful object. Agaricini and Polyporei are very common, and of most bewildering complexity of forms. Gasteromycetes are rare, and parasitic fungi of all kinds almost wholly absent. Even the cultivated plants are without rusts, smuts, mildews or leaf-spots.

AUGUST 19TH, AFTERNOON SESSION.

No papers were read.

AUGUST 22D, MORNING SESSION.

MRS. E. G. BRITTON: *On the proposed handbook of mosses of Eastern America.*—Drawings prepared to illustrate this work were exhibited and the general plan of the work described.

B. D. HALSTED: *Weeds and weed roots.*—Photographs of the plants described in his "Century of American Weeds," and also of the root systems of classified groups of these weeds were shown.

F. V. COVILLE: *The re-discovery of Juncus Cooperi.*

N. L. BRITTON: *The North American Amelanchiers.*—There appear two well marked species along the eastern coast: A. Canadensis, an upland form with birch-like leaves, and A. spicata, a swamp form of smaller growth and more spicate inflorescence. These do not appear to intergrade, but their western range and variations are not yet well known. Beside these two, the other species of the genus were briefly described and illustrated with herbarium specimens. The genus is believed to contain seven American species. Material for study, especially from the interior, is solicited.

J. C. ARTHUR: *A new form of root cage.*—This consists essentially of two glass plates held about an eighth of an inch apart by removable metal clips, between which the soil is placed and the plants grown. The glass plates are so close together that nearly or quite all the roots may be seen from one side or the other during the whole period of growth. The glass cage is set in a convenient zinc trough for holding water, and the roots protected from light by zinc sides. It is designed for the study of geotropism, the relation of roots to soils, etc.

N. L. BRITTON: *The botanical garden movement in New York.*—The present very favorable condition of the project for a New York garden was outlined, and the opinion given that it would be established in a year or two, and under favorable regulations for its scientific control. Dr. E. F. Smith expressed the gratification felt by all botanists that a garden of such size and prospective value was soon to be added to the few at present in America.

L. M. UNDERWOOD: *A few additions to the hepatic flora of the Manual region.*

AUGUST 22D, AFTERNOON SESSION.

MRS. E. G. BRITTON: *On the genus Campylopus in North America.*—After a general account of the genus, the author spoke of a new species, *C. Millspaughi*, which has been separated from *C. flexuosus*, with abundant material for distribution. Two other new species were mentioned, and drawings and specimens exhibited.

A. A. CROZIER: *Note on a recent outbreak of peach yellows near Ann Arbor, Michigan.*—Described isolated outbreaks of the disease, and its gradual spread from centers of infection, in such manner that the theory of its contagious nature was well borne out.

W. P. WILSON: *Some observations on Epigæa repens.*—This species, as well known, is polymorphic. It appears to have once been trimorphic, but now possesses all intermediate forms. The female flowers have no pollen, and usually no anthers, and sometimes even no trace of stamens. The male flowers are without stigmas. The staminate and pistillate plants are so distinct in appearance as to be told at a distance. The female form is the more vigorous and predominant, but seed production is rare. Prof. Halsted called attention to the fact that there was only one size of pollen.

N. L. BRITTON: *Notes on some species of Cratægus.*—The forms of this genus are many of them difficult to distinguish, and more material and study is needed. *C. flabellata* Bosc., an extremely rare form from Canada, and *C. glandulosa*, from Delaware, with large and abundant glands upon the inflorescence, need especial attention.

AUGUST 23D, AFTERNOON SESSION.

MRS. H. L. WOLCOTT: *Observations on the ripening of the seeds of Cuphea.*—Attention was called to a cultivated variety with large flowers, which pushed the placenta laterally through the walls of the ruptured ovary and calyx tube, bringing the immature seeds into the air to ripen. Dr. Britton mentioned that the adaptation also occurred in Cuphea viscosissima.

CHAS. MOHR: *Notes on the mountain flora of northern Alabama.*—This paper will soon appear in *Garden and Forest.*

The following papers still remained upon the program unread at the final adjournment:

A. S. HITCHCOCK: *Notes on some Kansas weeds.*

W. W. BAILEY: *Notes on the flora of Block Island.*

L. H. PAMMEL: *Notes on the distribution of a few plants.*

L. H. PAMMEL: *Phaenological notes for 1892.*

THEO. HOLM: *Notes on terminology.*

MRS. E. G. BRITTON: *On the genus Ditrichum in North America with one Western species and corrections for two Eastern species.*

THOMAS MORONG: *Notes upon a revision of the North American Naidaceæ.*

M. B. WAITE: *Notes on some pear and apple diseases.*

E. S. GOFF: *Modifications of the tomato plant resulting from seed selection.*

MRS. E. G. BRITTON: *Some of the rare mosses of White Top and vicinity recently collected on a trip to southwestern Virginia.*

J. C. ARTHUR: *Galvanotropism.*

A. A. CROZIER: *A botanical terminology.*

MRS. E. G. BRITTON: *A proposed collection of mosses of New York state for the Columbian Exposition.*

W. P. WILSON: *Climbing habit of Tillandsia usneoides.*

O. F. COOK: *Some general questions in the classification of Myxomycetes.*

J. M. COULTER: *North American Cacti.*

L. H. BAILEY: *Cultivated species of Brassica.*

P. H. ROLFE: *Notes on the distribution of plants in Florida.*

L. H. PAMMEL: *Notes on some fungi common during the season of 1892 at Ames, Iowa.*

BRIEFER ARTICLES.

Polygonum persicarioides HBK.—According to Hemsley (Biol. Cent. Am. III, 34) the range of this plant is from Mexico to Chili and Peru. It is represented in the National Herbarium by the Wilkes' Expedition plant from Lima, Peru; by an unnamed plant collected by Botteri near Orizaba, Mexico, and numbered 1163; and by three plants that had been referred to *Polygonum persicaria* L., viz., Palmer's no. 137, collected in 1885 in S. W. Chihuahua, Mex.: Palmer's no. 211, collected in 1887 near Angeles Bay, Lower California; and the Mexican Boundary Survey plant no. 1183, collected in the valley of the Rio Grande, below Donna Ana, N. Mex. Recently Mr. H. Wurzlow sent this species from Industry, Austin Co., Texas, which extends its range into the United States.

All these plants mentioned agree essentially with the description in HBK., Gen. Pl. II, 179, with some exceptions. First, the leaves are not glabrous below, but *above;* while *below* they are "beset with numerous minute hairs." I may add: midrib below and margin beset

with coarser appressed hairs in all our specimens. It must be that the first description is wrong on this point. Then, the leaves are in no case "7—8 lines wide," but ⅜ in. to ½ in.; the Angeles Bay plant having some leaves as wide as ⅝ in. Furthermore, the description has "Calyx 4-parted . . . Stamens 6 according to Bonpland. . . . Achene lenticular." I have frequently found the calyx 5-parted, stamens as many as 8, and the achenes in the Angeles Bay and the Orizaba plant—the latter from one of the stations cited in Biol. Centr. Am. l. c.—as well as in the Texas plant, are triangular: all, however, of the same size, and all "umbonate," as in the first description.

This species is distinguished from *P. persicaria* L. by its narrower, longer leaves, more slender spikes and smaller achenes.—J. M. HOLZINGER, *Department of Agriculture, Washington, D. C.*

New Mosses of North America.—The following brief diagnoses are published in advance of fuller descriptions in order to secure priority. We hope to prepare shortly the fifth number of our series under the above title, in THE BOTANICAL GAZETTE.

Dichodontium olympicum n. sp.—A D. *pellucida* jam multo robustiore primo visu differt: foliis valde papillosis, toto fere ambitu minute denticulatis, capsulaque basi strumosa. Planta humilis, vix 1 cent. alta.—Olympic Mts., Wash. (*L. F. Henderson.*)

Grimmia Hendersoni n. sp.—*G. decipienti* Lindb. (G. *Schultzii* Wils.) proxima sed ab ea pedicello longiore, capsula subcylindrica magis elongata, operculo longius rostrato et foliorum rete basilari multo laxiore facillima distinguenda.—Hood River, Oregon, on dry rocks. (*L. F. Henderson*).

Encalypta lacera n. sp.—Ab *Enc. vulgari* proxima differt calyptra basi lacerata, peristomio e membrana alba fugacissima lacerata composito et pedicello longiore.—Milwaukie, Oregon, Willamette River, (*L. F. Henderson*).

Leskea obtusa n. sp.—Formis robustioribus *L. polycarpæ* similis. sed ab illis primo aspectu foliis obtusis marginibus planis distincta, A *L. obscura* habitu valde robustiore, foliis majoribus et magis obtusis, costa breviore et capsula majore et longiore quoque differt.—Bethlehem, Pa., mixed with *Anomodon obtusifolius* (*Rau.*) Chinchuba, La., near Mandeville, on trees (*Langlois*).—F. RENAULD AND J. CARDOT, *Monaco, and Stenay, France.*

EDITORIAL.

THE RECENT upheavals in nomenclature, culminating in the work of Otto Kuntze, are too well known to need recapitulation. It had become evident to most botanists that some agreement must be reached or confusion would become worse confounded. This feeling found public expression in Europe in the circular recently issued from Berlin,[1] containing certain propositions which were submitted to working botanists for their signature. It is presumed that the results thus obtained were to be presented to the International Congress at Genoa. In this country a circular with the same purpose was sent out from New York and Washington, and was the means of discovering among botanists a wide-spread desire for an agreement upon matters of nomenclature. It was felt that work in systematic botany was losing force amidst the uncertainties of nomenclature, and that almost any laws were preferable to the existing chaos.

THE TIME therefore seemed ripe at the Rochester meeting of the Botanical Club for an attempt to reach some mutual understanding. As is shown in the account of the meeting, the attendance of botanists who have to deal with nomenclature was unusually large, and it was felt to be representative, especially when taken in connection with letters containing expressions of opinion from many who were absent. The subject was not sprung in a formal meeting, but about twenty-five botanists, representing every shade of opinion, met informally and thoroughly and frankly discussed every point. Every one was ready to make concessions for the sake of agreement, and the principles finally adopted represent a resultant of various concessions. It was felt that this amicable feeling must be strengthened by an immediate agreement of some kind, and that various details could be arranged afterwards. The principles proposed were adopted by the Botanical Club with remarkable unanimity, the only real question raised being as to the advisability of so rigidly restricting the publication of species, some thinking that distributed specimens bearing a name should be included.

IN THE OPINION of the GAZETTE the paper adopted represents a thoroughly wise compromise, alike honorable to all concerned in its preparation, as witnessing a far greater desire to steady nomenclature than to hold fast to individual opinion. This is the spirit in which it should be received by all American botanists, and small differences of opinion should be lost sight of for the general good.

THIS ACTION of American botanists will be presented at Genoa, as

[1] See this journal for August, p. 267.

representing their proposition in the direction of an international agreement. As it is not widely different from the Berlin propositions some agreement may be reached, but we should not be too sanguine concerning this. If the Genoa Congress adopts a set of principles so little at variance with our own that complete agreement is possible, the standing committee is authorized to submit the matter to a vote (by mail) of the American botanists.

IT WAS a wise thing to appoint a standing committee to prepare a tentative list of the flowering plants of the so-called "Manual range" under the rules adopted and present it at the next meeting of the Club or of the new Botanical Section of the American Association. This will give the most conspicuous example of the working of these rules that could be selected from our flora, and botanists can have before them a concrete illustration, and can then determine whether the principles adopted work reasonably well or not. In the opinion of the GAZETTE the changes that will follow in Manual names will be much fewer than many suppose.

IN THIS CONNECTION it may be well to call attention to a single provision of the adopted rules; which is, to make 1753 (Linn. *Sp. Plant., ed. 1*) as the common point of departure for both genera and species. This will do away with a number of generic names that have been recently revived, and is better in this regard than the Berlin proposition, which takes the fourth edition of Linnæus' *Genera Plantarum* (1752) as the point of departure for genera. If the 1753 date is adopted at Genoa, the list of genera which are proposed by the Berlin circular as exceptions will be shortened, and in fact so few that concern American botanists will be left that they should not be considered when involving a dangerous precedent.

THE ROCHESTER MEETING bids fair to mark an epoch for American botanists. Not only was an agreement concerning nomenclature reached, but botany was dignified by being made a distinct section of the American Association. It will be long before section G sounds as home-like as section F, but as the botanists were suing for the divorce it was graceful to leave the house in the possession of zoology. However, the divorce is not complete, for provision was made by which joint sessions are to be held for hearing papers of general biological interest. The GAZETTE has so frequently given the reasons that have been urged for this separation that they must be familiar. The same reasons were overwhelmingly evident at Rochester, where the flood of botanical papers was beyond all precedent. The botanists are now responsible for a section, and they can begin the preparation of papers for the next meeting in the full assurance of having not only time for a hearing, but also for discussion.

THE ACTION of the Botanical Club, of course fully representing the new section G, in reference to the International Botanical Congress in connection with the Columbian Exposition, was thoroughly prudent. By correspondence and by personal investigation it had become sufficiently evident that a very meager representation of European botanists could be expected, and that nothing was to be gained by coöperation with the World's Congress Auxiliary. It seemed somewhat absurd to call a meeting of American botanists an "International Congress." However, the attractions of the year are to be taken advantage of, and foreign botanists urged to attend the meeting of the Botanical Club, which has a committee appointed to do all it can towards making their stay pleasant and profitable.

CURRENT LITERATURE.

The lower cryptogams.[1]

Professor Ludwig of Greiz is known as one of the most energetic German students of the mutual relations between plants and animals, and of the fungi, especially those connected with some of the obscure gum diseases of trees. For a series of years he has reviewed mycological literature for Just's Jahresbericht, which has caused him to become quite familiar with the work being done by specialists in that field, so that his text-book is unusually rich in references to recent work. The book is essentially a review of the thallophytes, with especial reference to economic questions, nearly 600 pages being devoted to the fungi, and only about one-tenth as much to the algæ, inclusive of lichens. A full index makes reference to the cryptogams themselves, as well as host plants, etc., quite easy, although the hosts are indexed only under their common names. The book appears to be carefully and well written.—W. T.

Minor notices.

PROFESSOR GREENE'S *Pittonia* (vol. II, pt. 11; May–Aug., 1892) contains a very interesting paper upon Dr. Kuntze and his reviewers, chiefly the latter. The reviewers referred to are Hemsley (*Nature*), Jackson (*Jour. Bot.*), Britton (*Bull. Torr. Bot. Club*), and Schumann

[1] LUDWIG, FRIEDRICH.—Lehrbuch der niederen Kryptogamen, mit besonderer Berücksichtigung derjenigen Arten, die für den Menschen von Bedeutung sind, oder in Aeushalte der Natur eine hervorragende Rolle spielen.—8vo, pp. xvi+672. Stuttgart, Enke, 1892.

(*Nat. Rund.*). The reviewer of reviews, while acknowledging in a general way that he may have been even more radical than Kuntze, cannot subscribe to all his views, although this probably refers to certain minor points. He points out very clearly that this much criticised author has the merit of consistency in his application of the "Paris Code," a fact which would seem to indicate that the time has come to guard the workings of the code. Professor Greene regards Kuntze's work as the most important contribution to the literature of nomenclature that has ever been made and one for which all botanists should be grateful, an opinion which THE GAZETTE has already expressed.

IN THE SAME publication Bentham's genus *Linanthus* is restored to include some twenty-five species which have been usually placed under *Gilia*. Many new species from the wonderful Pacific coast flora are also described.

PROFESSOR A. C. APGAR is the author of a small book dealing with the trees of the Northern United States[1]. There can be no doubt that the trees are too much neglected by pupils in botany, and that many a person becomes familiar with the herbaceous flora of his neighborhood without being able to recognize the trees. This book is prepared for the easy determination of our trees, cultivated as well as indigenous. As it does not profess to be written for the professional botanist it should be judged merely from its adaptation to its audience. An easy analytical key to genera is provided, and illustrations are plentifully sprinkled through the text. There is no reason why this book should not be very useful in enabling students to become acquainted with trees, a thing much to be desired.

DR. W. J. BEAL AND MR. C. F. WHEELER have published a catalogue of Michigan plants[2], which is based upon the Wheeler & Smith catalogue of 1880. The pamphlet contains some 70 pages of valuable prefatory material, discussing from numerous points of view the flora of the state, and including many group lists. The catalogue contains 1746 numbers, including the pteridophytes. The publication is a valuable addition to our increasing list of useful local catalogues.

---

[1]APGAR, AUSTIN C.—Trees of the Northern United States, their study, description and determination, for the use of schools and private students. 8vo. pp. 224. American Book Company: New York, Cincinnati, Chicago.

[2]BEAL, W. J. and WHEELER, C. F.—Michigan Flora. Prepared for the 30th Ann. Rep. of the Sec'y of the State Board of Agric. 8vo. pp. 180. Lansing, 1892.

OPEN LETTERS.

Dr. J. P. Campbell's "Biological Instruction."

I was interested to read in the last number of THE GAZETTE an appreciative review of the recent work of Dr. J. P. Campbell of the University of Georgia concerning the methods of biological instruction in American colleges and universities. On account of the inadequate treatment given the subject of botany in the chapter of Dr. Campbell's work which refers to the University of Minnesota, I wrote asking him to explain why he had neglected a department which might have claimed some attention in such a book as he was putting forth. I received from him a reply that is so complete an exposition of his intellectual position and capacity for undertaking the broad treatment of biological instruction in the United States that I cannot refrain from giving a few sentences wider circulation. Since the letter was in no way confidential I feel at liberty to do this. Dr. Campbell begins by exhibiting great surprise and indignation that I should have dared to call him to account for his inaccuracies. He says: "I am not accustomed to being called to account and asked if I 'have any explanation to offer' nor do I recognize the right of any one to do so, and this letter is only written on the assumption that you expressed yourself more strongly than you thought." In reply I called Dr. Campbell's attention to the fact that in the taking up of such a work as he had attempted he had exposed himself to criticism, and that he would find as his experience in publishing grew wider he might often merit and receive criticism and correction. He assures me in his letter that a circular was sent from Washington to the professor of biology at each institution and from the replies to these circulars his work was compiled. I am informed by Professor C. W. Hall (at that time professor of biology at the University of Minnesota) that he received no such circular; but one was received by the professor of *animal* biology, Dr. H. F. Nachtrieb. This indicates the care with which Dr. Campbell's circulars were sent out. Further, in the list of teachers there was no mention of Professor Hall's name while there was of Professor Nachtrieb's, showing how carefully this table was arranged.

Observing the extraordinary and altogether unnecessary impression that Johns Hopkins University seemed to have made upon Dr. Campbell I took occasion in my letter to him to express my high appreciation of the zoölogical work done at that institution and my very low appreciation of the biological work done by any institution where they are willing to omit one-half of the science. Indeed I indicated a certain feeling of contempt for the burglarious use of the word "biology" which is permitted at this institution which has had such an extraordinary influence upon American biological instruction. To this Dr. Campbell replies with characteristic vigor and enthusiasm. He says: "I cannot help thinking if you had stayed longer at Johns Hopkins and caught more of the spirit of the place you would have found that the instruction in biology is not by any means 'weak' as you are pleased to term it, but that it has taken its present form, so far at least as the strictly undergraduate work goes, simply because they are unhampered by traditions and are free to carry out their ideas of the

relative importance of subjects, and these I admit are a little in advance of the times. In the five years that I worked there I frequently heard the value of botany insisted upon for training children and I also heard Dr. Martin emphasize the necessity of studying animal and vegetable forms together as in the general biology course."

We have here the pleasing suggestion that botanical work is of value for training children! It would be difficult to ask for a more perfect exhibition of the spirit with which Dr. Campbell came to his task of writing a broad account of biological instruction in America. I should be far from holding Johns Hopkins responsible for any indiscretion of Dr. Campbell, but under the circumstances it seems a matter of distinct regret that any institution in America should permit a man to graduate from a five years course in biology with the notion that the science of our food-supply, to put it upon a purely economic basis to say nothing of any other, is a fit thing to amuse children with. It is, too, an interesting thing to note in these days of specialization, that it is the zoölogist who wishes to talk of "biology" (which is after all only a synonym of the old phrase, "natural history"); while the botanists, recognising the twin sciences, are willing to give each a place and name. It is possible that the botanists are somewhat in advance of the times, as Dr. Campbell would say.

I have written thus at length because I feel that I am in a position to show the botanists of the country somewhat of the animus that has been displayed in the compilation under government control of what should have been a valuable, accurate, broad-minded, adequate and complete account of the biological work in American colleges. It is unfortunate that it was intrusted to a gentleman who after five years of what he supposes is biological instruction—and I have no reason to think that Dr. Campbell is insincere in supposing that he is a biologist—has the pleasant way of characterising botany as valuable for the training of children.—CONWAY MACMILLAN, *University of Minnesota, Minneapolis.*

NOTES AND NEWS.

MR. W. W. CALKINS has some interesting words regarding the study of lichens in America, in *Science* for August 26.

PROFESSOR GEO. F. ATKINSON has been appointed Assistant Professor of Cryptogamic Botany at Cornell University.

MR. HENRY E. SEATON, Instructor in Botany in Indiana University, has been appointed Assistant Curator at the Harvard Herbarium.

DR. GEORGE VASEY is the accredited representative of the Department of Agriculture and Smithsonian Institution to the International Congress of Botanists at Genoa.

A PRESENTATION of the question of priority in botanical nomenclature from the ethical point of view is given by Prof. L. M. Underwood in *Science* for Aug. 26 (xx, 16).

THE OFFICERS of the new section of botany, G, of the A. A. A. S. for the ensuing year are Dr. Charles E. Bessey of the University of Nebraska, vice-president, and Mr. F. V. Coville, of the U. S. Division of Botany, secretary.

DR. J. C. ARTHUR returned from his European trip early in August, and reports that some botanists, including a few of the most renowned, will probably visit this country next year, but the number is not likely to be large.

PROFESSOR WM. R. DUDLEY, of Cornell University, has been appointed Professor of Systematic Botany at Stanford University. Professor Dudley's work will largely be in the direction of studies in geographical distribution, for which the University is so favorably situated.

FOR THE FIRST TIME in the history of the Botanical Club there was no excursion or reception designed especially for botanists during the recent meeting. The local committee tendered an afternoon excursion to the Club, however, which could not be accepted for lack of time. Upon Saturday each botanist chose the excursion he preferred, there being no pre-arrangement.

DR. B. L. ROBINSON has been appointed Curator of the Harvard Herbarium, and arrangements have been made by which he can have time at his disposal for the completion of the Synoptical Flora. It is the present intention to push this great work as rapidly as possible, an intention which will be warmly commended by American botanists, who were fearful that it might be abandoned altogether.

THE BOTANICAL INSTITUTE at Munich, Germany, is prospering greatly under the management of Prof. Dr. Goebel, who took charge less than a year ago. The building has been renovated, and a considerable addition is now in course of construction, which will contain laboratories for physiological work. The supply of alcoholic and dried material for illustrative purpose has also been much increased, and a series of charts of large size has been specially prepared.

THE CONSPICUOUS ITEMS in the proceedings of the Rochester meeting of the Botanical Club are: (1) the nomenclature agreement; (2) the appointment of Professor Underwood as the Club's representative at Genoa; (3) the action with reference to an International Congress of botanists in connection with the Columbian Exposition; (4) the appointment of a committee to define the terms "range," "locality," "station," and "habitat"; (5) the appointment of a standing committee to prepare a list of plants of the "Manual range" under the adopted rules.

NO SMALL PART of the credit for the large attendance of botanists at the recent gathering in Rochester, and for the unusually full list of papers presented before the Botanical Club, is due to Mr. D. G. Fairchild, the secretary of the Club. By correspondence and solicitation before the meeting he was enabled to present upon the first day of the session a long list of names of those who had signified their intention of being present, and of papers which were to be read. It is

work of this kind which creates and sustains unusual interest in scientific gatherings, and it is a pleasure to note the disinterested and efficient manner in which the present secretary of the Club has performed such self-imposed duties.

THE FOLLOWING PAPERS were read before the Botanical Sub-Section of the British Association for the Advancement of Science, on Friday, August 5th, at the meeting in Edinburgh: "A proposed World's Congress of Botanists at Chicago in 1893," by Dr. J. C. Arthur of La Fayette, Ind., U. S. A.; "Observations on secondary tissues in monocotyledons," by Dr. Scott and Mr. Brebner; "On the simplest form of mosses," by Prof. K. Goebel of Munich, Germany; "On the cause of physiological action at a distance," by Prof. Léo Errera of Brussels, Belgium; "Notes on the morphology of the spore-bearing members in the vascular cryptogams," by Professor Bower; "Notes on an aposporous fern-seedling," by C. T. Druery; "A Chytridian parasitic on Cyclops' eggs," by Prof. M. Hartog; "Arrangement of the buds in Lemna minor," by Miss Nina Layard. Other botanical papers were read on the following Tuesday.

A RECENT ANNOUNCEMENT of the University of Minnesota states that the laboratories of botany occupy a suite of rooms in Pillsbury Hall, viz: (1) herbarium and seminar rooms, (2) a student's morphological and chemical laboratory, (3) an experimental physiology laboratory, (4) a special laboratory, office and reading room, (5) a dark room, (6) a special work room. These with other rooms give a floor space of 6,000 square feet. The laboratory contains microscopes, auxanometers, clinostats after Pfeffer's patterns, thermo-electric apparatus, a Mackintosh lantern, microtomes after Minot and Jung-Thoma, centrifugal wheels, induction coils, heliostat, Lautenschlager's bacterioscopic and sterilizing apparatus, water-motor, balances, thermometers, etc., giving full facilities for elementary, advanced and original work in the field of botany, considered in its widest sense. The herbarium contains over 60,000 specimens. A botanical museum and economic collection has been begun.

IN VIEW of the fact that the nomenclature agreement was the result of a movement inaugurated by the Berlin circular, published in the last number of the GAZETTE, and of the New York and Washington circular, the principles proposed by the latter are here put on record:

I. The adoption of initial dates for generic and specific names.

II. That the publication of a generic name or a binomial specific name invalidates the use of the same name for any subsequently published genus or species.

III. That in the transfer of a species to a genus other than the one under which it was first published, the original specific name is to be preserved, unless such name has previously been employed in the genus to which the species is transferred; and if the author who transfers such species alters the name, it may be restored by any subsequent author.

IV. That a varietal name be treated as equal in rank to a specific name, in its relations as a homonym and in the transfer of species and varieties from one genus to another.

BOTANICAL GAZETTE

OCTOBER, 1892.

A preliminary comparison of the hepatic flora of boreal and sub-boreal regions.[1]

LUCIEN M. UNDERWOOD.

The distribution of the hepatics of boreal and sub-boreal regions is becoming sufficiently understood to form some sort of a basis for comparative study, and while we yet have much to learn even of the best studied region of northern Europe, and still more from the higher latitudes of America and Asia, we can even now profitably gather some statistics and make some comparisons.

While it has long been known that the bryologic flora of the northern portions of both hemispheres was similar, so far as we know no exact comparisons have been instituted, on the hepatic side at least, to determine the nature and extent of this similarity. In the north temperate and arctic zones there are known about 575 species of Hepaticæ. Of these 375 belong to the flora of Europe, 300 to that of America, and perhaps 150 to that of Asia. Of these we may take as representing the boreal and sub-boreal portions, 173 species for northern Europe, 163 for northern America, and ninety-eight species for northern Asia. This will include in Europe, Scotland, North Germany, Scandinavia, and northern Russia, with the islands of Iceland and Spitzbergen; some of the species also extend to the higher Carpathians, the Alps and the Pyrenees; for America the colder regions from Newfoundland and Labrador to British Columbia and Alaska, including Greenland (whence some sixty species are known); and extending southward along the higher Appalachians as far as the Carolinas, and probably southward along the present *incognita* of the Rockies and the Sierras; for Asia it includes only the coastline of northern Siberia[2], for of the interior of Siberia, Turk-

[1]Read before Section F, A. A. A. S., Rochester meeting, August, 1892.

[2]Our knowledge of the north Asiatic flora is summarized in the following:—Lindberg and Arnell: Musci Asiæ Borealis. Kongl. Svenska Vet. Akad. Handl. No. 5 (1889). Mitten: An enumeration of all the species of Musci and Hepaticæ recorded from Japan. Trans. Linn. Soc. 2nd Ser. III. 153-206 (1891).

estan, the most of the Mongolian empire, and Thibet to the north slopes of the Himalayas, our knowledge of the hepatic flora is almost an absolute blank.

For our knowledge of the hepatic flora of boreal America we are indebted largely to the collections of two men, John Macoun, who has collected hepatics since 1866 from Nova Scotia to Little Slave Lake and the confines of Alaska, and Rev. Arthur E. Waghorne, who has collected in recent years in Newfoundland and Labrador. From these two collectors alone we have examined over a thousand packets of hepatics during the past three years. In addition we have the results of the labors of Mr. Pearson[1] on Macoun's earlier collections, and the still earlier collections of Drummond, which were worked up by Taylor whose collection at Cambridge furnishes considerable material bearing on the northern species. The Greenland flora has been summarized by the Danish botanists[2], and several collectors (Krause brothers, J. M. Macoun, Miss Cooley, and others) have taken scattering species in Alaska. The bryology of that region, however, demands much more thorough exploration than has hitherto been given it.

The difficulties arising in the systematic study of these northern collections are fourfold:—

1. The similarity of the American to the European flora, rendering necessary a thorough familiarity with all the European species, varieties and forms.

2. The undue refinement of specific distinctions made by recent European hepaticologists especially in the genera Scapania, Cephalozia, Marsupella, Nardia and Jungermania.

3. The confusion introduced by periodic upheavals of nomenclature, notably by Lindberg among the Scandinavian species, which very largely interlace with those of America.

4. Absence of many types and inaccessibility of most that are in existence; combined with this are the conflicting opinions of European authorities regarding the autonomy and identity of many species, and the misleading character of many European exsiccatae.

In spite of these difficulties, we are gradually getting order out of chaos, and hope in time to have the American forms satisfactorily co-ordinated with the European.

---

[1] List of Canadian Hepaticæ, 1890.

[2] Lange: Hepaticæ in Meddelelser om Gronland, Tredie Hefte, pp. 407-421 (1887).

As most of this paper is necessarily statistical, we present only some of the leading features of a detailed study of the three floras:—

1. Of the 214 boreal and sub-boreal species, eighty per cent. are European, seventy-six per cent. are American, and forty-six per cent. are Asiatic. While the larger part of the species of Europe and America have been brought to light, it is quite likely that the smaller number known from the more extensive Asiatic continent is due to the limited exploration of that region.

The distribution by orders can be seen as follows:—

	Species common to Europe, America, Asia.	Species common to Europe and America.	Species common to Europe and Asia.	Species common to America and Asia.	Exclusively European.	Exclusively American.	Exclusively Asiatic.
Ricciaceæ,	4	6	5	4	1	1	–
Marchantiaceæ,	7	9	10	7	1	1	–
Anthocerotaceæ,	–	2	–	–	–	–	–
Jungermaniaceæ,	56	112	70	58	24	32	10
Totals	67	129	85	69	26	34	10

Further percentages will appear in the following:—

	Number.	Per cent. of all boreal species.
Circumpolar species	67	31
Species common to Europe and America	119	60
Species common to Europe and Asia	85	39
Species common to Asia and America	69	32
Endemic species of Europe	26	12
" " of America	32	15
" " of Asia	10	4

2. Of the 163 American species, 129 or seventy-eight per cent. are of the European flora; sixty-nine are also Asiatic, while thirty-two or twenty per cent. are endemic.

3. Of the ninety-eight Asiatic species, eighty-five (or eighty-six per cent.) are European, while only ten (ten per cent.) are endemic.

4. Of the 173 European species only twenty-six, or fifteen per cent. are endemic, and this number is likely to be reduced by further exploration of the Asiatic and American floras.

5. 67 species encircle the pole being found in America, Europe and Asia. The percentage of these circumpolar species varies among the orders; while only 30 per cent. of the

boreal and sub-boreal Jungermaniaceae are circumpolar, there is a rise to 44 per cent. in the Ricciaceae, and to 50 per cent. in the Marchantiaceae. No species of Anthoceros are yet reported from Asia, although two species are common in northern Europe and America.

6. As might be expected certain northern hemisphere genera predominate. The genera Jungermania, Scapania, Marsupella and Cephalozia form 41 per cent. of the Hepaticae of all Europe, while the same genera of the northern portions form 46 per cent. of the species. For America the corresponding per cents are twenty-five and thirty-seven. Forty-seven per cent. of the flora of northern Asia is made up of the three genera, Jungermania, Cephalozia and Scapania, the genus Marsupella being strangely absent from that flora. Some comparisons of the larger genera will show more clearly the tendency of certain genera to increase relatively northward:—

	EUROPE.		AMERICA.	
Genera.	Per cent of all species.	Per cent of boreal spec.	Per cent of all species.	Per cent of boreal spec.
Riccia,	6 9	4	6.6	3.7
Aneura,	1 8	4	2	3
Cephalozia,	7	10	4 3	8
Frullania,	1 8	1.7	7	5.5
Jungermania,	19	22	14	19
Lejeunea,	3.7	1.1	7.6	1.9
Marsupella,	7 7	7	1.6	2.4
Nardia,	3 2	2.3	2 6	3
Radula,	3	0.6	3.6	1.8
Scapania,	6 9	6.3	4.3	7 3

While the above table shows the relative increase of such northern genera as Aneura, Cephalozia, Jungermania, Marsupella and Scapania, it also shows the relative decrease of such warm temperate and tropical genera as Riccia, Frullania, Lejeunea and Radula. It also shows the excessive development of Frullania and Lejeunea in America, and that of Cephalozia, Marsupella and Jungermania in Europe.

7. The ninety-eight north Asiatic species are distributed among thirty-seven genera, nineteen of which are monotypic; of these all but three are also American; Peltolepis and Prasanthus are found in Europe but not in America, while Calycularia alone is endemic.

8. Of the boreal species of Europe two genera only are not represented in either America or Asia.[1] These are

[1] Of the European genera of lower latitudes Corsinia, Riella, Tessellina, Acrobolbus, Adelanthus, Calypogea, Gymnoscyphus and Petalophyllum have not been found in America.

Pleurozia and Scalia. All the genera of boreal Ameria are European.[1]

9. The following genera common to Europe and America have not yet appeared in the N. Asiatic flora: Aitonia, Anthoceros, Fossombronia, Herberta, Hygrobiella, Jubula, Liochlaena, Marsupella, Pallavicinia and Pleuroclada.[2]

10. The following comparisons of some of the larger genera are further illustrative:

	EUROPE.			AMERICA.			ASIA.		COMMON TO			
	Total species.	Boreal species.	Endemic.	Total species.	Boreal species.	Endemic.	Total species	Endemic.	Europe, Asia, America.	Europe, Amer.	Europe, Asia.	Asia, America.
Riccia	26	7	15	20	6	9	5	–	4	10	5	4
Fimbriaria	7	2	4	7	2	4	2	–	2	3	2	2
Anthoceros	5	2	2	12	2	9	–	–	–	3	–	–
Aneura	7	7	2	6	5	1	3	–	3	5	3	3
Cephalozia	27	18	14	13	13	3	9	–	5	9	8	6
Frullania	7	3	4	21	9	18	2	–	1	3	1	1
Jungermania	73	38	41	43	31	17	29	4	19	26	25	19
Lejeunea	14	2	9	23	3	18	·	–	–	5	–	–
Marsupella	29	12	25	5	4	1	–	–	–	4	–	–
Nardia	12	4	7	8	5	4	1	-	–	4	1	–
Plagiochila	7	3	0	7	4	0	2	–	1	3	1	2
Porella	7	4	1	11	6	6	2	1	1	6	1	1
Radula	10	1	9	11	3	10	1	–	1	1	1	1
Scapania	26	11	16	13	12	5	8	–	6	8	8	6

11. The following species are circumpolar, inhabiting America, Asia and Europe.

Riccia bifurca
  crystallina
  fluitans
  glauca.
Asterella hemisphaerica
Conocephalus conicus.
Fimbriaria fragrans.
  pilosa.
Grimaldia fragrans
  (*G. barbifrons.*)
Marchantia polymorpha.
Preissia hemisphaerica.
Aneura latifrons.
  palmata
  pinguis.
Anthelia Juratzkana.
Arnellia Fennica.
Bazzania trilobata
Blasia pusilla
Blepharostoma trichophyllum.
Cephalozia bicuspidata.
  catenulata.
  fluitans.
  multiflora.
  pleniceps.
Chiloscyphus polyanthos.
Diplophyllum taxifolium.
Frullania dilatata.
Geocalyx graveolens.
Gymnomitrium coralloides.

[1] Of American genera of lower latitudes Cryptomitrium and Thallocarpus only are endemic.

[2] Together with Sphaerocarpus, Dumortiera, Lunularia, Targionia and Notothylas from lower latitudes.

Harpanthus Flotovianus.
Jungermania alpestris.
attenuata.
autumnalis.
barbata.
bicrenata.
excisa.
exsecta.
Floerkii.
incisa.
inflata
Kunzeana.
lycopodioides.
minuta.
porphyroleuca.
pumila.
quinquedentata.
saxicola.
sphaerocarpa.
ventricosa.
Kantia trichomanis.
Lepidozia reptans.
Lophocolea heterophylla.
minor.
Mylia anomala.
Odontoschisma denudatun
Pellia epiphylla.
Plagiochila asplenoides.
Porella platyphylla.
Ptilidium ciliare.
pulcherrimum.
Radula complanata.
Scapania curta.
irrigua.
subalpina.
uliginosa.
umbrosa.
undulata.
—67.

12. The following additional species are common to Europe and America, but have not yet been reported from boreal Asia[1]:

Riccia natans.
sorocarpa.
Clevea hyalina.
Grimaldia rupestris.
Anthoceros laevis.
punctatus.
Aneura multifida.
sinuata
Anthelia julacea.

Bazzania deflexa.
Cephalozia curvifolia.
dentata.
divaricata.
Lammersiana.
Chandonanthus setiformis.
Diplophyllum albicans.
Dicksoni.
obtusifolium.
Fossombronia Dumortieri.
Frullania fragilifolia.
tamarisci.
Gymnomitrium concinnatum.
obtusum.
Harpanthus scutatus
Herberta adunca
Hygrobiella laxifolia.
Jubula Hutchinsiae
Jungermania capitata.
cordifolia.
Helleriana
Hornschuchiana.
Michauxii.
riparia
Kantia arguta.
Lejeunea calcarea.
serpyllifolia.
Lepidozia setacea.
Liochlaena lanceolata.
Lophocolea bidentata.
Marsupella brevissima.—*(M. adusta.)*
emarginata.
sparsifolia.
sphacelata.

---

[1] Twenty additional species from lower latitudes are common to Europe and America, bringing the percentage of European species exactly to 50. The remaining species are:

Riccia ciliata.
lamellosa.
nigrella.
tumida.
Sphaerocarpus terrestris.
Fimbriaria elegans.
Lunularia vulgaris.
Targionia hypophylla.
Anthoceros caespiticius.
Fossombronia cristata.
Jungermania laxa.
Lejeunea minutissima.
Rossettiana.
ulicina.
Lophocolea crocata.
Nardia hyalina.
Odontoschisma sphagni.
Pallavicinia Lyellii.
Pellia calycina?
Porella thuja? —20.

Metzgeria conjugata.
furcata.
pubescens.
Mylia Taylori.
Nardia compressa.
crenulata
scalaris.
Pallavicinia Hibernica.
Pellia endiviaefolia.
Plagiochila interrupta.
spinulosa.
Pleuroclada albescens.
islandica.
Porella rivularis.
laevigata.
pinnata.
Scapania compacta.
nemorosa.
Trichocolea tomentella. —62.

13. The following are common to Europe and Asia, but have not yet appeared in American collections:

Riccia minima.
Grimaldia pilosa.
Peltolepis grandis.
Sauteria alpina
Cephalozia bifida
connivens.
myriantha.
Jungermania Badenensis.
heterocolpa.
Jungermania Kaurini
Limprichtii.
longidens.
Wenzelii.
Nardia Breidleri
Pellia Neesiana.
Prasanthus Suecicus.
Scapania apiculata.
rosacea. —17.

14. The two following are found in Asia and America, but not in Europe:

Cephalozia Macouni.
Plagiochila porelloides.

15. The following boreal and sub-boreal species are found only in Europe:

Riccia Michelii
Clevea Suecica.
Aneura fuscovirens.
incurvata.
Cephalozia biloba.
Francisci.
integerrima.
Massalongi.
serriflora.
spinigera
Hygrobiella myriocarpa.
Nevicensis.
Jungermania nardioides.
Jungermania rigida.
Marsupella alpina.
Boeckii.
condensata.
filiformis.
Funckii
intricata.
obcordata.
varians.
Pallavicinia Blytii.
Pleurozia purpurea.
Scalia Hookeri.
Scapania Spitzbergensis.
—26.

16. The following are the endemic American species:

Riccia lutescens
Aitonia erythrosperma.
Cephalozia extensa.
minima.
Sullivanti.
Chiloscyphus ascendens.
Diplophyllum argenteum.
Frullania Asagrayana.
Chilcootiensis.
Hallii.
Nisquallensis.
Frullania Oakesiana.
Selwyniana.
Jungermania colpodes.
Gillmani.
Groenlandica.
tesselata.
Vahliana.
Wallrothiana.
Lejeunea Macounii.
Lophocolea Leibergi.
Macounii.

Nardia crenuliformis.
Odontoschisma Macounii.
Porella navicularis
Ptilidium Californicum.
Radula arctica.
Radula Krausei.
Scapania albescens.
Bolanderi.
glaucocephala.
Oakesii. —32.

17. Last of all are the ten species peculiar to Asia:

Calycularia laxa.
Diplophyllum plicatum.
Frullania Davurica
Jungermania fertilis.
guttulata.
Jungermania quadriloba.
Sahlbergii.
Lophocolea reflexula.
Mylia verrucosa.
Porella grandiloba.
—10.

De Pauw University, Greencastle, Indiana.

Bacterial investigation of the sea and its floor.[1]

H. L. RUSSELL.

No class of living organisms, animal or vegetable, have been found to be so ubiquitous in their distribution as bacteria, yet strange to say, no especial attention has been paid to the investigation of the marine waters of the globe from a bacteriological standpoint. True it is that the phosphorescent forms of the sea have been more or less thoroughly worked out, and here and there other isolated forms have been described, but the general subject of the bacterial flora of the sea has been left quite untouched. It is not my purpose here to enter into any elaborate discussion of this subject, but only to give a short résumé of work along these lines which I have been carrying out for the past two summers, and also to suggest some problems of interest in connection with this subject.

I fully recognize the futility of attempting to draw any general conclusions from a comparatively small number of tests, but while the results which I have to offer may be regarded as somewhat provisional and will require extended confirmation before they can be accepted as general biological facts, I trust they may possess some interest even in thistenta tive connection.

The results, which I can only briefly summarize here, were obtained at the Zoological Station at Naples, during the

[1] Read before Section F, A. A. A. S., Rochester meeting, August, 1892.

spring and summer of 1891, and at the Marine Biological Laboratory at Wood's Holl, Massachusetts, during the past season.

These widely separated places, so different in many of their conditions, gave exceptional advantages for a comparative study along these lines.

Before detailing the results, I will state, in the briefest possible manner, the methods used in the work. First, in regard to the manner of procuring the material for examination: In securing this for a quantitative bacterial determination, it is necessary that the sample secured should be kept free from contamination, as far as possible, from the time it is originally taken until the growth of the cultures has been completed. To do this with material from surface-soil or air is not especially difficult, but when the material is to be derived from the ocean floor, or at varying depths in the water, the problem of keeping it uncontaminated during its withdrawal is by no means easy. The conditions must be such that the possibilty of contamination during withdrawal will be excluded. The apparatus which is quite universally used to collect samples of deep water for chemical and physical analysis is here of little use as it cannot be previously sterilized, but the following method which has been thoroughly tested for two consecutive seasons and has given most excellent satisfaction is believed to fulfil all the conditions necessary for the work.

It consists of a large sized test tube which is tightly fitted with a rubber cork having a single hole. The opening in the cork is closed by a glass tube which projects about three-quarters of an inch below the lower end of the stopper. The upper part of this small tube is bent at right angles to the long axis of the collecting tube and drawn out at a certain point to a finer caliber, so that it may be quickly sealed in an ordinary flame. The different glass parts are first sterilized by heat, the rubber corks being kept in mercuric solution, then rinsed in sterile water and finally dried on sterile filter paper. These are then tightly fitted together and a partial vacuum produced either by attaching the small tube to a vacuum pump or by expelling a portion of the air by heating the tube with a small amount of hot water or dry heat. The end of the small tube is sealed as the air is expelled. The vacuum tube may then be protected from gradual leakage by coating the cork with a mixture of beeswax and rosin.

To secure the samples of water from any desired depth, these vacuum tubes are attached to a holder by means of an ordinary clamp, the small drawn out glass tube being so arranged that the point of it lies near the connecting line that is fastened to the holder. When the holder with the vacuum tube has been sunk to the desired depth, a lead messenger is sent down over the connecting line and as it is caught on the top of the holder, the small glass tube is broken and the vacuum thus destroyed. The collecting tube fills quickly with water (usually from about two-thirds to three-quarters full) and then the apparatus is quickly hauled up. By virtue of the imprisoned air which can not possibly escape, owing to the projection of the small glass tube below the rubber cork and the rectangular bend in the tube, water is absolutely prevented from entering the tube after the first partial filling.

Cultures are made in the ordinary way by taking 1 cc. of the water after it has been thoroughly shaken up, mixing it with nutrient sea water gelatine and then plating it in Petri dishes instead of using the regulation Koch plate.

The apparatus which has been used to secure material from the sea bottom is theoretically imperfect, i. e., it does not fulfill one of the cardinal bacteriological canons—previous sterilization, but in its practical workings, I am satisfied that it delivers samples of the sea bottom quite uncontaminated from the water layers above. It consists of an ordinary iron tube (a gas pipe serves the purpose admirably) pointed at one end. The other end is fitted by means of a screw with a removable "sleeve," the upper end of which is closed by a valve. As the weighted instrument descends, the water passes through the pipe and as it strikes the sea floor, it is forced into the soil so that it is filled with a compact mass of material. As the instrument is withdrawn, the pressure of the water closes the valve from above so that no water enters the pipe during its withdrawal. The cohesive nature of the ocean slime is quite sufficient, except where pure "live" sand is present, to hold the mud column in the tube.

The mass of mud is removed from the tube by means of a piston rod, and from the center of this mass a known volume of the material is extracted by means of sterilized brass tubes. For this purpose a small sized cork borer is well suited. This known volume of mud is then diluted with a definite volume of sterile water and plated as in the other case. The only

possible chance for contamination is from diffusion which might take place from the sides and lower end of the iron tube. The material is within this for so short a time however, that in so solid and dense a mass as the mud core, this element of error has, I believe, little or no effect.

Attention may now be directed to some of the problems which arise in connection with the investigation of marine bacterial life. Space will only permit a reference to one or two phases of the work, and I can only briefly recapitulate some of the results which have already been obtained.

First, in regard to the presence of bacterial forms in the sea. To determine the bacterial content of the sea, it is necessary for one to secure material outside of the contamination limit from the land. This is of course a varying distance, depending upon the configuration of the shore and other conditions. Fresh water or sewage germs discharged into the sea soon perish on account of the change in their nutritive medium. Of course any quantitative determination of the bacterial contents of the sea must exclude all samples taken within this limit. To my knowledge, the surface water of the sea has not been analyzed bacteriologically at any great distance from land, but samples taken from the coastal line outside of land contamination show that micro-organisms are invariably present in the water. The number per unit of volume varies naturally within certain limits, yet there is on the whole quite a constant average number per unit of measure in these surface waters.

Examination of the *superficial* water layers has always revealed the presence of micro-organisms and it may be interesting to note in this connection the vertical distribution of germ life in the ocean. Are the marine waters peopled *throughout* with bacteria, or is this life confined to the warmer surface waters of the ocean? According to the researches of the Challenger, the marine fauna is separated into a superficial and an abysmal zone, while the intermediate depths are quite deficient in animal life. Analyses of the water at Naples taken at different depths from the surface down to a depth of 3,200 feet showed that bacteria were present in *all* cases. No zonary distribution was to be observed in any case and the intermediate depths as well as the water immediately above the sea floor were found to contain germs in about the same proportion as at the surface.

The usual content of the sea water ranges from 10 to 150 germs per cc., while in exceptional instances the number per unit of volume exceeded this; but the fact that the individuals present were in these cases usually of a single species indicated that the large number was due to a bit of zoogloea rather than active vegetative forms. A comparison of salt with fresh water shows that on the whole bacterial life is less abundant in the sea than in fresh water. The higher temperature of the latter and its proximity to land masses, which are nearly always extremely rich in bacterial organisms, are sufficient to account for this increase.

A bacteriological examination of the sea bottom shows that it, too, is filled with bacteria.

Observation demonstrates that the sea-floor is infinitely richer in germ life than the waters above it. A quantitative examination of the ocean bottom shows a wide variation in its bacterial contents. Just what factors bring about this difference in numbers, I am unable, as yet, definitely to state, but it seems more than probable, that the variable physical character of the sea flora, the depth at which material is taken, and the influence of temperature are conditions which largely determine the presence of micro-organisms. As might be expected, it will require an extended series of data gathered under similar as well as diverse conditions before the question of distribution can be satisfactorily explained. I shall only attempt to submit certain facts which have been brought out by the work, leaving a definite explanation until more thorough investigation.

At Naples, the investigation of the sea bottom was made from the shore line to a depth of 3,500 feet. At the depth of 150 feet and two miles from land, the sea floor contained from 200,000–300,000 germs per cc. From this number, it fell very rapidly as the depth increased until at the depth of 700 feet only 25,000 germs per cc. were present. From this depth to the deepest point investigated (3,500 feet) the number of germs remained tolerably constant. When these results are graphically represented, they show a marked coincidence with the temperature curve of the Mediterranean at this point. The Mediterranean being a closed basin is not subject to the general oceanic circulation and the temperature of the great mass of its water remains at a constant point. The summer temperature of the surface ranges from 77°–82° F., but this

falls rapidly to 55° F. at a depth of 600 feet, and from this point downward there is no change.

This season's work which has been carried on at Wood's Holl in much more northern and cooler waters shows that the bacterial content of the sea bottom is very much less abundant at this point than in the Mediterranean. In the vicinity of Wood's Holl I was unable to reach any great depth on account of the width of the shallow continental plateau which lies off southern New England and the middle Atlantic states. The number of bacteria per unit of volume was found to be, under similar conditions very much less than at Naples. The germ contents of the slime from Buzzard's Bay averaged from 10,000 to 30,000 germs per cc. This is scarce more than a tithe of what was present in the Mediterranean mud at equal depths.

When we find the mud so much richer in bacteria than the water, the question naturally arises, to what are these results due? Is the ocean bottom merely covered with the spores of the water bacteria that have finished their cycle of development, and then like the remains of the foraminifera slowly sunk to the bottom, or is bacterial life here present in its fullest activity? The answer to these questions may be sought in two ways. Qualitative analysis of the water and the underlying mud will demonstrate whether the species found in the two habitats are analogous or not. If we find the deposit made up entirely of species similar to those found in the water above, even though they may be very much more numerous, it is at least presumptive evidence that the mud owes its bacterial flora to the superimposed water masses. On the contrary, the presence in the mud of species which are *only* to be found in this habitat is evidence that the ocean bottom is filled with forms which are indigenous to this stratum. Qualitative analysis of the Naples mud showed three very prevalent forms which made up at least thirty-five per cent. of the entire bacterial content of the sea slime. These were wholly indigenous and were not found in any cases in the samples of water taken at any depth. A similar result has been reached in the work at Wood's Holl. Two species are most prevalent in the water, together with two or three other forms that are occasional inhabitants. Now the mud contains the two prevalent water forms, it is true, but in addition to this, there is another common form that usually makes up from thirty to fifty per

cent. of the whole number present, and is an indigenous slime bacillus. Besides this species there are two or three other species that are exclusively mud inhabitants although they are by no means so common as the one previously mentioned. I say exclusive, but this is not entirely true, for in two or three cases water cultures made at Wood's Holl have revealed species which had been supposed to be indigenous slime forms. These apparent exceptions can, however, be satisfactorily explained, for they were taken at localities where the tidal currents were strong and there is scarcely any doubt that they were detached from the mud by means of these currents much as the wind detaches bacteria from the soil and carries them about in the air.

The presence of these *indigenous* mud forms necessarily implies that they exist in a vegetative condition, but this can also be experimentally determined. Samples of the mud were taken and treated in the ordinary way in which cultures were prepared. The diluted material was then heated at a temperature sufficiently high to kill all the vegetative forms (80°C) but not enough to destroy the vitality of the spores. Cultures were then immediately made from the heated material and the actual condition of the individuals as they existed in the sample used, could thus be ascertained. These two sets could then be directly compared and the difference in the number of colonies gave the approximate number of vegetative forms actually present in the water or mud. This proportion is often a widely variable one but the analysis of a score or more samples show that the mud bacteria as well as the water forms are in a large degree in a vegetative condition, even under such adverse conditions for their development as those that are found at the bottom of the deep sea.

Mention has only been made so far, of the distribution of marine bacteria in general, but the vertical range of the different species also shows some interesting features. This bathymetrical range, *i. e.* the maximum and minimum depth limits of growth, which each species possesses, varies in different cases.

Great difference in depth means such a marked change in the environment of any single species that one might reason *a priori* that the same species would not be able to adapt itself to such widely different conditions. It is a well authenticated fact that such environments have brought out specific modifications in the faunal life of the sea.

Of the three most common mud forms found at Naples, the maximum depth limit of growth was not attained at the depth of 3500 ft. One of the three species *(Cladothrix intricata)* had nearly disappeared from the cultures, so that it was reasonable to suppose that the bathymetrical range had been almost reached. The other two species were at this depth sufficiently numerous to indicate that the maximum point of development had not been attained. This fact is of especial interest when we consider it in the light of the pressure experiments[1] which have been carried out on bacteria.

Our knowledge of the action of high pressure upon bacterial metabolism is as yet imperfect, but there are several forms which seem to bear an increase of pressure of upwards of 100 atmospheres without material change.

A comparative study of the Mediterranean forms and those found on the New England coast gives an opportunity for a direct comparison from a specific as well as from a numerical standpoint.

The work during the present season has been mainly confined to Buzzard's Bay and Vineyard Sound off the Massachusetts coast, but through the kindness of Prof. Wm. Libbey, Jr., of the U. S. Fish Commission, samples of the mud were obtained about 100 miles from the shore at the depth of 100 fathoms. They were taken by the schooner Grampus on the edge of the great continental platform, which is skirted by the Gulf Stream. The samples are the farthest from land that have ever been analyzed bacteriologically, and give substantial evidence that the ocean bottom is peopled with bacterial life, to at least this distance from shore. Another interesting feature was determined by these analyses. The two prevalent slime species at this point were found to be the same as those taken from near the shore at Woods Holl. This proves a geographical distribution of the common mud species for at least 100 miles from land. A comparison of these forms with those at Naples shows a marked dissimilarity. The number of indigenous forms in the water and mud is not especially large in either case. One of the most interesting species found in the Mediterranean is an endosporous, pseudo-branching form, Cladothrix intricata, which was there quite frequent, but a rare species on the Atlantic coast. This indicates that this species, at least, is quite cosmopolitan in its distribution. Aside

from this form, the other species were quite unlike, although they possess some similar characteristics. The bacteria that are so universally present in sea water and mud seem to be quite peculiar to this habitat. Of course many land and fresh water forms are carried into the sea by drainage, but sooner or later, most of them succumb to the changed conditions of their existence.

With this *introduced* or *adventive* flora, we are not especially concerned, but aside from this, there are these certain well defined species, that seem to be indigenous to this particular habitat. By long residence in salt water, some of them have become so modified, that they grow much more luxuriently upon media made from sea water than upon that which contains only the normal amount of salt. In one of the species isolated at Naples, this specialized saprophytism was as well marked as in the case of certain pathogenic species which are cultivated upon artificial media with only the greatest difficulty. Time will not permit any further discussion of this question of marine microbiology and these disconnected statements will be closed with a few suggestions as to the more important problems presented in this line of work.

Aside from the subject of geographical and vertical distribution of bacterial life and the forces which produce these results, there are various problems which possess a morphological as well as a physiological interest. For example, the inner structure of the bacterial cell—the relation of the karyoplasm to the cytoplasm and the cell membrane—a subject which at the present time in this group is imperfectly understood can, I believe, be better demonstrated with marine species of bacteria than the great majority of other forms. As a rule, the individual cells are relatively large and the protoplasm instead of being homogenous is highly granular.

Besides these morphological questions, there are many of a physiological character, such as the relation of bacteria to phosphorescence;their connection, if any, with deep-sea decomposition; the influence of high pressure incident to depth; and the changes in their oxygen supply, which might be profitably considered.

Much of this class of work can be best done under the auspices of the government, either by the Fish Commission or the Coast Survey, as these departments are already provided with the necessary outfit of vessels fitted with suitable dredg-

ing apparatus, etc., for deep sea work. Unfortunately, the methods of work preclude the use of preserved material, as this subject can only be prosecuted by means of culture work. Not only would such a department of research upon our scientific exploring expeditions add greatly to our knowledge of bacterial life, but the lower forms of fungi could be investigated as well.

University of Chicago.

A peculiar case of plant dissemination.

EDWARD L. BERTHOUD.

Studying lately with intense interest "Island Life," by Alfred Russell Wallace, and his remarks upon the dissemination of plant life everywhere, both on continents and islands, it brought to my mind what many years ago I had observed during a long residence, and numberless scouts, excursions, surveys and pleasure trips I have made in the region included between the Missouri river and Great Salt Lake, and from the $34\frac{1}{2}°$ N. latitude to that of Eau qui Court in Dakota, and Sun river in Montana.

As these may be of interest and some value in the determinations of geographical botany, and have a bearing in the elucidation of geological botany, I will briefly give the more salient points of these observations. I can show to some extent that between the Missouri river and the Rocky mountains, the American buffalo has been an efficient agent in plant dissemination. Until within twenty-six years the buffalo was known to range from Peace river and Athabaska valley to central Texas. Very much as our Indian tribes are known to do, the buffalo uniformly followed trails in their annual migrations from north to south, or *vice versa*, very rarely deviating from them, whether across prairie or woods, or over spurs of the Rocky mountain range, on their migrations through South, Middle, North Park and Laramie Plains. And when in the spring the former countless herds from Texas moved north across the Arkansas, Smoky Hill, Republican and Platte rivers, the same trails were used, the same river fords crossed, and, following the best ground for their migrations, their sagacity or instinct (if you choose so to call their

inherited faculty) made them follow trails over the lowest and best divides between streams.

When following large herds in Nebraska, Kansas, Colorado, Indian Nation and Texas, we have seen these trails in soft rich ground worn down five or six feet deep, thirty or forty feet wide, as well defined as a graded wagon road.

We have spoken of their migration only in a sense restricted to our personal knowledge in the region we have already described. Yet from the best information we can get we find that this same yearly change of locality occurred in northern Idaho, Montana and Dakota, and north of the Black Hills, not so much from scarcity of forage, as the necessity of shelter from the winter snows and blizzards of the upper Missouri and Yellowstone prairies; while in British America, according to the accounts of Franklin, Richardson, and also Messrs. Milton and Cheadle for the Saskatchewan and upper Athabaska valleys, the buffalo were driven by snow and intense cold from the open country into the timbered valleys, and forests west of the open plains and in the Athabaska region.

In the spring the general movement of the buffalo was north into Nebraska, Colorado, Wyoming and Kansas across the Arkansas river, then north to lat. 44° or even farther, and largely governed by the more or less abundance of grass and water, but as early as May vast herds were already in the Platte valley, invading the vast prairies of Dakota and Nebraska. In the fall the returning herds would be seen in October in the Platte valley, or even as far as the Arkansas.

These points explained and shown, we will now explain in what manner this bears on the question of the dissemination and intermingling of plant life within the limits given in this discussion.

The American buffalo, a good deal as their congeners in the eastern hemisphere, delight in rolling and plowing up with their horns the soft, muddy soil of the prairies, or of any bluff bank; rolling around they formed countless numbers of shallow depressions, circular in shape, very often retaining rain water for days, which were familiarly known as "buffalo wallows."

So that along deep, wide trails, and in the wallows, the sod being worn away, and the soil loosened and trampled up, large areas would be conspicuous by nourishing and perpetuating a new growth of plant life, introduced, generally or altogether foreign to a prairie country, and of such species as found these conditions favoring their growth.

We would find there Plantago (2 species), Asclepias Syriaca, Trifolium, Thlaspi, Amarantus, Chenopodium album, Martynia proboscidea, Sinapis, Portulaca, Lippia cuneifolia, and the grasses, such as Cenchrus, Stipa, Setaria, Elymus, Dactylis, Deschampsia, Panicum Crus-galli, Euphorbia, Glycyrrhiza, Epilobium.

We could add to this list Helianthus, but as this plant is firmly established as a native to the soil of this whole region, and universally appears along old roads and in all the valleys, its dissemination seems to be largely independent of artificial dissemination, and dependent for its spread solely on the bared condition of the ground when sodless. We have so far given what annuals or biennials are found in the artificial denudations made by the buffalo. To these we can add Rhus glabra, and a plum called "sand plum," a low spreading bush, two feet or less in height, abundant south of the Arkansas and in the Indian Nation. It was found by me near old buffalo trails in north Colorado, up to near North Platte in Wyoming. The same can be said of Rhus glabra, which in Colorado, at the foot of our Rocky Mountains, has been introduced since 1860; and found in Wyoming as far north as the forty-second parallel: the plum might be, perhaps, the Prunnus pumila, but may be only a variety of P. Chicasa, though I can hardly admit this as probable.

Now how do the buffalo distribute all these plants and shrubs, which so fix themselves in the places artificially formed in this whole vast region? An inspection of the enormous pad of hair four to twelve inches long that clothes the whole front of the buffalo's head from the root of the horns nearly to the muzzle, besides the dense long hair that clothes the legs and breast of the animal, reveals masses of hair, matted with mud, seeds, twigs cactus fronds and roots.

When examining the heads of dead buffalo I repeatedly noticed, matted in the long hair of the forehead, the woody two-tined capsules of Martynia with the seeds of the plant; also seeds of Bidens, Glycyrrhiza, Stipa, Setaria, Elymus, the seeds and pappus of Helianthus and other unknown Compositæ, hispid twigs of Euphorbia, and seeds of some species of Rhus, perhaps R. trilobata very common in Colorado, seeds of Obione canescens, and seeds either of Amarantus or Chenopodium. The pad altogether made up an ambulant Wardian case.

Now such a pad of hair (overlooking the breast and legs of the animal) matted as we have said, and daily rubbed in earth banks or wallows, is as good an apparatus for artificial dissemination as could be imagined when we consider the range and habits of the animal. Given a herd of ten thousand buffaloes roving from the Red River of Texas to northern Nebraska and Montana, we can justly imagine that the seeds of southern species of plant and shrub life would in time be left at intermediate points most favorable to their growth, while the returning herds in the fall and winter would be laden in the same manner with northern plant seeds to be in their turn dropped or left many miles south of their former habitat. Nor is it necessary that any one species of the plants should be conceived as forcibly carried from Texas to Montana by one migration; on the contrary taking the case of Martynia, a seed brought from Red river is dropped in a favorable spot on the Arkansas in some trail or wallow. There it matures seeds mayhap for years; some of them are again entangled in the forehead or the front woolly hairs of a buffalo on its neck or fore legs and are finally dropped by chance on the Smoky Hill or Republican The same actions may recur, and the plant seeds be carried into the next valley or to the next prairie divide, so that in course of time it is not at all improbable that any one species of plant would finally reach the uttermost northern limit of the buffalo's northern range, the plant being, as it were, slowly acclimated by the successive transference from age to age in its continued dissemination. What we argue in relation to the Martynia, can equally apply to any plant or shrub seed, varying in its northward or southward progression just in proportion to its adaptability to withstand heat or cold, drouth or moisture, and its adaptation to extraneous transportation.

Now, if we turn to Richardson's Appendix to his Arctic expedition we find that he gathered *Opuntia glomerata* at the Lake of the Woods, while others have found it since near Lake Winnipeg. The occurrence of such a southern type of plant about latitude 50° to 51° north, we believe was largely due to a progressive dissemination by the buffalo, not only by seed, but also by direct conveyance of fronds and roots. This transfer we conceive highly probable, as well as that of many other plants and shrubs that range into British America from as far south as latitude 35° and 36°. We are certain

the sand plum has advanced from the Arkansas river into northern Colorado and Wyoming, since in the scope of the buffalo country extending from the forks of Platte river to the Rocky Mountains, I have found it only where the main buffalo trails formerly existed. Rhus glabra is, however, such a cosmopolitan shrub, that its dissemination north may be as justly ascribed to recent settlement as to the artificial dissemination we have advocated.

Again, if the fossil sequoias, figs, magnolias, oaks, palms, liquidambars, cycads, salisburias, laurels, persimmons, cinnamonums, aralias, sassafras and many other semi-tropical or south temperate trees and shrubs now found in the Cretaceous, Eocene and Miocene beds of Colorado, were derived from the Arctic regions originally; and if their modified descendants now found extant from the Missouri river south to the Mexican gulf are their living representatives, then it is quite remarkable that no representatives of the cactus family occur either in Greenland strata or in the same formations in Colorado. Their total absence also from the Pliocene strata of South Park, so rich in Sequoia, Glyptostrobus, Myrica, Rhus, Sapindus, Ficus, Planera, Cesalpinus, Acacia, Zizyphus, Ilex, etc., though really only negative evidence of their non-existence there, is strongly corroborated by the fact that the Opuntia is a plant that avoids damp, densely timbered surfaces. It delights in dry, stony, sandy soils, and requires but little water the whole year round. The vegetation of the Cretaceous, Miocene, Eocene and Pliocene strata in Colorado predicates the presence of rich, damp soils, either of valleys or low humid plains. Although the presence of fossil cacti has never yet been proven in any of the formations we are now considering, the fleshy nature of the fronds of Opuntia would naturally be very unfavorable to fossilization; but its abundant seeds of a very hard consistence, would be unusually well fitted for preservation, for we find to-day in the strata under consideration fossil nuts of Fagus, Corylus, Carya, Diospyros and a species of plum, besides palm nuts, fern fronds with sporangia complete, seeds of grasses and carices, also of elm and Planera.

The reader may ask what has all this to do with the question of "buffalo pads." The answer is simple enough. We think we prove very strongly by this that the cacti that extend from southern latitudes to Lake Winnipeg, are colonies that in the

course of ages have been gradually acclimated by artificial dissemination, and not the fragments of a flora derived from Arctic regions. Granting this, then the same method would apply to Clematis Virginiana, Negundo aceroides, Ampelopsis quinquefolia, Prunus (Cerasus) serotina, Cornus, Shepherdia argentea, Sambucus pubens, Hypopitys; all found according to Richardson far north in the British possessions, within the old buffalo range, but also common as far south as latitude 35° north.

Golden, Colorado.

Notes on certain species of Erythronium.

E. B. KNERR.

Perhaps there is no more interesting genus of plants among Liliaceæ than Erythronium. The species are the first of the order to appear in the spring and in point of beauty are second to none. Besides, there are features of propagation quite as puzzling and wonderful as any to be found.

Of the three species to be mentioned *E. Americanum* Ker. is the most common in the eastern states, *E. albidum* Nutt. in the central and western states to Kansas and Nebraska, while *E. mesochoreum* Knerr belongs to the states of the lower Missouri valley. All three species present two kinds of plants: a flowering two-leaved and a flowerless one-leaved form, both of which arise from underground corms. In the flowering forms these corms, or rather fleshy bulbs, consist of a series of corms arranged somewhat spirally one within the other, sometimes as many as four or five in number, the youngest innermost, each corm producing its plant in succession a year apart and beginning with the oldest and outermost. Sometimes, however, in E. mesochoreum and E. Americanum it happens that two and even three of these corms may develop at once, producing as many leafy scapes apparently from the same root, when ordinarily but one would be expected. As yet I have never noticed this in E. albidum.

The sterile forms (one-leaved) both of E. Americanum and E. albidum, and sometimes the flowering, send out underground off-shoots or rhizomes which produce at their extremities new corms destined to furnish the plants of the next season. In the two species, however, there is this difference:

E. albidum usually sends out but two (though sometimes specimens are found with but one such rhizome), a strong vigorous one and a second that is weaker and smaller. In E. Americanum the number is usually from three to five, successively diminishing in size, all more or less coiled and twisted. In E. albidum they are much straighter and somewhat deeper rooted. E. mesochoreum never produces such rhizomes, so far as we have observed, either in the one-leaved or in the two-leaved forms.

Herein we readily find an explanation for the multitude of the one-leaved forms of both E. albidum and E. Americanum wherever they occur; for in the case of the first species where this year was but one plant, next year will be two; and in the case of the second species even a greater number will appear, a plant for each new rhizome. Thus it is that whole slopes of shaded ravines become carpeted with these beautifully mottled leaves. Only one here and there of the thousands is destined to develop a corm without offshoots, which in a season or two may send up a flowering scape to produce seed and propagate its species sexually.

Right here arises an interesting question: What selective power is it that determines the one in the ten thousand, which is thus to reach fruiting?

We are reminded that this same question arises in other branches of biology wherever propagation is secured by both the asexual and the sexual processes. The reply usually given is that the conditions lie in the food supply, a very plausible answer for the most part, but we seriously doubt its sufficiency.

As such rhizomes producing corms at their extremities are entirely wanting in E. mesochoreum, sterile forms in this species are comparatively rare, and those that do occur are seedlings soon to become fertile flowering forms. Hence it is that where this plant is established there is no lack of bloom in the flowering season.

The leaves of E. albidum and E. Americanum are very similar in appearance, being both very conspicuously mottled with various shades of green and purple, especially in the early part of their blooming season; but those of the latter species are usually broader and flatter than those of the former. We have noticed that this mottling disappears to a great extent, especially in E. albidum, as the season advances, the color be-

coming almost a uniform bright green and then fading to yellow as the leaves wither. But as yet we have sought in vain for unmottled forms of *young* E. albidum mentioned in the botanies. The third species, E. mesochoreum is never mottled, especially when young, though we have found a few specimens that showed a faint mottling in lighter shades of green when the season was much advanced. The leaves of this species are also much narrower and longer than those of either the other two, being mostly linear-lanceolate, and indeed even linear in some specimens.

The habitat of these plants is also characteristic, E. albidum and E. Americanum preferring deep shaded ravines and moist meadows, while E. mesochoreum takes to the hill-tops and the north facing slopes whether wooded, or open and covered with grass.

The color of the sepals is also distinctive, E. Americanum being yellow with purple dots at the base, E. albidum white tinged with pink, and E. mesochoreum also white, but tinged with lavender or blue. The perianth of the last is usually much longer than that of E. albidum and is not so much reflexed in the bright sunshine.

The stigmas of E. Americanum are peculiar, being massed into a club-shaped body; those of E. albidum are quite divergent and somewhat recurved; while in E. mesochoreum they are more slender and decidedly recurved. The capsules of this last species are also much larger and longer than those of either the other two and everything indicates that the seed is also more vigorous, a fact naturally to be expected seeing that this form propagates rather sparingly by the bulb.

Midland College, Atchison, Kansas.

BRIEFER ARTICLES.

Notes upon Daucus Carota.[1]—The early introduction of this plant, from its European soil and environments, and its present wide distribution, and ready adaptation to new conditions make it a good type from which to expect those variations of habit, structure, etc., which usually attend the transplanting of a new organism with new conditions. Records of the numerous changes which it has undergone

[1]Read before Section F, A. A. A. S., Rochester meeting, August, 1892.

prove that it is no exception to the general laws of variation. Leaving out of all account the extended variation among the cultivated varieties which are quite as marked as among others of its congeners, my purpose in this note is to call attention to the range of variations to be found in the weed in a state of nature. This tendency is quite marked, and has often been noted. One of the more common and constant phases of variability is to be fouud in the floral umbel. The presence of a single, central flower, springing from the immediate center of the disk, and of a deep purple color, in distinction from the generally pure white of the entire umbel, is a feature that has been known for some time, though I am not aware that any record has appeared in any recent literature.

Another feature nearly as general and constant is the presence of a peripheral circle of larger flowers, mostly sterile and radial, though this is not universally the case, and for this reason, as probably in the preceding case no special record has been made of the fact.

During the present summer I have observed certain other variant phases which seem to be somewhat new, as a very considerable extent of inquiry among leading botanists has failed to elicit any corresponding observations. The features to which reference is here made are two. *First:* The extension of the unique colored and sterile features of the central flower to the whole central umbelet. This I have noted in quite a large number of cases. *Second:* The implication of the entire umbel in the coloration. This feature was by no means as general as the last, but was quite marked in many individuals. My first thought upon observing it somewhat casually was that it was probably due to the same cause which leads to the assumption of purplish hues by many white flowers as they age toward withering. Subsequent observations, however, showed that this could not be the case; as in those plants exhibiting the phenomenon at all, it was quite as marked in the earlier phase of flowering as at any other. This, together with the observed tendency of the central purple flower to involve the whole central umbelet in its peculiar color, renders very strong the conviction that it is a case of variation, which in time may become quite general and permanent.

My first observations on these points were made in the vicinity of Cold Spring, L. I., but have subsequently been verified upon specimens in this vicinity, and I doubt not may be found occasionally in many localities, though I had not noticed them at all in the middle western states.

It is quite remarkable that notwithstanding these and other features of variation, the divergence has not been sufficiently marked or con-

stant in any one direction to give rise to new species, or even to well marked varieties.—CHARLES W. HARGITT, *Syracuse University, Syracuse, N. Y.*

Cross and self-fertilization.—In a series of experiments, still in progress at this college, on the fertilization of the common petunia, the following results were obtained from the first generation.

One dozen petunias of equal vigor were selected from the greenhouse cuttings, and put into pots of equal size, and subjected to exactly the same conditions. About half of the plants were the dull purple variety, nearly the original type, while the others were variegated and somewhat modified. Each blossom was very carefully excluded from accidental fertilization, by being tied in a paper bag, or by having the corolla tied together tightly until the capsule had begun to develop.

There were three series of experiments. The blossoms of series I were self-fertilized; those in series II were fertilized from other blossoms on the same plant; and in series III they were fertilized from other plants.

Series I bore capsules averaging 1.8 centigrams in weight, series II bore capsules averaging 2.7 cgms. in weight, and series III bore capsules averaging 4.1 cgms.

In series I and III, the seeds of the plain purple and the variegated specimens were weighed separately, showing the variegated to be lighter. In series I the purple weighed 0.7 cgm. more than the variegated in the same series. In series III the purple bore capsules 0.2 cgm. heavier than the variegated in the same series.

It was also noted that many more capsules in series III developed and ripened perfectly than in either series I or II; while series I ripened the smallest percentage of capsules. Owing to various accidents no definite figures could be obtained to show the exact proportions.

Thus it may be inferred that even in the first generation the deteriorating effects of self-fertilization are plainly shown; and also the tendency of much modified plants to decline in vigor and productiveness.

Darwin, in his book on cross and self-fertilized plants, page 189, says: "In crossing six blossoms, there were six seed capsules produced, weighing 4.44 grains; while six others were self-fertilized, producing only three capsules weighing but 1.49 grains."

This experiment is interesting from the fact that it agrees with Darwin's very similar experiment on the same plants.—MINNIE REED, *State Agricultural College, Manhattan, Kas.*

CURRENT LITERATURE.

Last volume of a great work.[1]

The task of collecting and issuing in uniform manner all the specific descriptions of fungi ever published, although requiring prodigious labor, has been accomplished by the author of the Sylloge Fungorum in a remarkably short time, and the final volume now lies before us. The ten volumes of the work contain about forty thousand species. How many of these names are synonyms is the part of the monographer and special student to determine. Excellent judgment has been shown throughout in the compilation, and the work will not only be a monument to the perseverance of the author, but of inestimable and lasting service to mycologists.

The present volume does not differ essentially in its make up from the preceding, except in possessing a universal index to the cohorts, families, genera and their synonyms of the full ten volumes. The series closes most appropriately with an enumeration of fossil fungi, embracing 331 numbers, compiled by Dr. A. Meschinelli.

Although this is the last volume of the work as projected, Dr. Saccardo offers to issue addenda, if authors will kindly continue to send him their publications. He states that at the time this last volume came from the press (June, 1892,) some fifteen hundred species, *incredibile dictu*, had already come in, too late to be included. Such evidence of activity in the collection and study of fungi indicates how highly serviceable such addenda must be to all working botanists.

The flora of the Dakota group.[2]

This invaluable contribution to the fossil flora of North America was the last work of Leo Lesquereux, who died in the fall of 1889. It is composed of a vast number of leaf-drawings, identified and named by the deceased author, and portrays the forests that once existed in this country. At the same time it shows the broad range of this scientist's work, whose childhood was spent among rocks, trees and flowers in the heart of Switzerland. From these early influences Lesquereux naturally turned in time to the study of botany, to which he devoted the greater part of his life. In the year 1848 he came to

[1] SACCARDO, P. A.—Sylloge fungorum omnium hucusque cognitorum Vol. x, supplementum universale; Pars II, Discomyceteæ—Hyphomyceteæ, additi sunt fungi fossiles auctore Doct A. Meschinelli. Roy. 8 vo, pp. 964. Patavii, 1892. —Francs 48.

[2] LEO LESQUEREUX.—The flora of the Dakota group, a posthumous work, edited by F. H. Knowlton, U. S., Geol. Survey. 256 pp., 66 plates. Washington, 1891.

America to become our foremost paleobotanist. His great enthusiasm soon made him familiar with our flora, and we need only to look at the work he has left us to get an idea of his talent and indomitable energy. His last, as well as his previous works are well fitted to stimulate our paleobotanists. As it will be impossible to give a complete review of this voluminous work, we point out a few of its characteristic features, as shown in the original way, by the author himself.

How full of interest, for instance, are the figured leaves of *Liriodendron*, illustrating the transition to ancestors with deeply lobed or even pinnatifid leaves, sometimes of gigantic size, but with the characteristic truncate apex, until another form appears with the terminal lobe preserved as in *L. semialatum*. The comparison of these very different types might seem hazardous, did the carefully drawn figures not show a striking accordance. We note one exception only: the nervation of the leaf (plate XXIX, fig. 3) appears somewhat different from a true *Liriodendron*. Comparing the genus *Sassafras*, we find a large, five-lobed leaf with margin entire (*S. dissectum*), while *S. cretaceum* var. *grossidentatum* and *S. papillosum* show similarly lobed leaves, but with dentate margins. These last forms seem, however, hardly to belong to the genus *Sassafras;* the leaf figured on plate VI, fig. 7, agrees in most respects with a leaf of a *Platanus*, closely related to *P. occidentalis*. We wonder also why the author did not consider the leaves of *Sassafras dissectum* and of *S. subintegrifolium* (plate XIV, figs 1 and 2) as one species, since these two forms are easily recognized in our recent *S. officinale*. We find, too, a number of leaves of Heer's *Betulites* united into one species by Lesquereux, who gives in the text a most valuable account of the variation of leaves on this tree, and calls attention to the fact, that if these leaves had been found separately, at different times and in different localities, they might have been referred to a number of species.

There is, altogether, in this work — not only in the text, but also in the numerous illustrations — abundant material for further studies. Besides describing and enumerating the species of the Dakota group, as far as it is known at the present time, including ferns, cycads, conifers and phanerogams to the number of 460 species, the author gives an analysis of the entire flora. A general sketch of this highly interesting flora is given with critical notes upon the types occurring there, for instance of *Liriodendron*, *Sassafras*, *Quercus*, *Ficus* and many others. The study of these plants has led to the conclusion "that the flora of North America is not at the present epoch, and has not been in past geological times, composed of foreign elements brought to this continent by migration, but that it is indigenous; its types are native,

and the diversity of their representatives has been produced by physical influences. The affinities, therefore, or the relation of their modification or derived forms can not be looked for in the vegetation of distant countries."

As the work is left by the author, although unfinished, it commends itself, and the author's name will always be remembered with admiration and gratitude. But we are unable to leave his work without a few remarks about the manner in which it has been edited.

In looking through this book, we are surprised at the number of errors, apparently of carelessness, such as mis-spelling, incorrect citations, omission of figures, misleading terms, etc. The editor seems not to have understood the responsibility of editing a posthumous work. The best method of editing a posthumous work is, undoubtedly, to carry it out in the same spirit in which it was started, taking all facts into consideration. It must not be forgotten that Lesquereux was an old man, who, in the later years of his life, became unable to keep informed as to recent publications, and that his views in some respects belonged to past times. Then, too, there are many things that are admissible in a manuscript, written as the thought first comes to us, and pleasing for the time to the fancy, which should be omitted in print. We dare say, that in its present form, this work would never have been published by the author. The reader will readily observe the wide gap between the genial and elegant work of Lesquereux, and the lack of care and taste in the present edition.

Although it is as unpleasant a task to criticise a posthumous work as it is delicate to edit it, we must note some of the deficiencies in the edition. The plates, which form the most important part, and which should have been a guide to further studies, are poorly arranged. The genera ought to have been so placed as not to require one to look over a large number of plates, widely separated from each other, to find the species of each genus. This is the case, for instance, with *Protophyllum*, *Ficus*, *Sassafras* and most of the large genera. It would have been an easy matter to arrange them in good order. Several of the figures are designated by numbers so distant from the respective illustrations that it is hard to tell to which figure the numbers belong. Some of the illustrations are not named at all, and others are not numbered. The spelling of names is inconsistent in a great many instances: we have both *grossi-* and *grosse-dentatum*, *cissioidès* and *cissoides*, besides numerous others. Often the specific name is of the wrong gender as: *Fagus orbiculatum*, *Sassafras primiginea*, *S. artica*, *S. Pfaffiana*, etc. The descriptive part contains some misleading phrases; e. g.: " dots like the impression of basilar points of hairs"

(p. 98), "a bunch of small pediceled seeds like those of *Carex*" (p. 62). Furthermore there is a too indiscriminate use of terms: e. g., basal, basilar and basil — the last of which is the name of a plant, but is written in the manuscript as an abbreviation of basilar. In the descriptions of the nervation it is a difficult task to understand the terminology. From *Protophyllum denticulatum* (p. 193) we cite the following: "median nerve," "lateral primaries supra-basilar," "secondaries with their divisions," and finally, "nervilles!" The nerves figure under several names: veinlets, nervilles, etc., which are not technically correct. On page 92 we learn that "the nerves are attached to each other." Again it is remarkable that such an expression could escape the editor's attention as this from p. 243: "*Diospyros Virginiana* being the only species remaining in the present North American flora." Such mistakes might easily have been corrected, but we are sorry to say that these and many others have been allowed to pass by the editor whose duty it would seem to have been to correct them.

We regret that this valuable work of Lesquereux has not met with a more satisfactory treatment as to correctness and form. The spirit and skill of the author has failed to find in the editor due appreciation and sufficient painstaking for so important a work.—TH. HOLM.

The Minnesota Catalogue.

IN THE PRESENT confusion of ideas with regard to the larger groupings of plants it is as well, perhaps, for authors of local lists as well as more extended manuals to try to express our present knowledge of plant affinities. Such an attempt is now before us in Professor Conway MacMillan's introduction to "the Metaspermæ of the Minnesota valley." This introduction, reprinted in advance, is intended to be a statement of the principles and classification to be followed in the forthcoming enumeration. The principles enunciated are those familiar to all who consider the subject of nomenclature, which is now in a fair way to be so happily settled. We much regret that so sprightly a young author should see fit to include in this part of his very readable pages any insinuations as to unworthy motives governing those who are counted as conservatives in this matter. Differences of opinion there must always be, but courtesy demands that a man shall be taken to be honest in any public expression of his views. As to the proposed groupings: two great divisions are used, Protophyta and Metaphyta, based upon the absence and presence of sexuality. Metaphyta are further subdivided into Gamophyta and Sporophyta, dependent upon the development or not of a distinct sporophyte. Sporophyta are then subdivided into Thallophyta, Archegoniatæ, and Metaspermæ, whose names practically describe their limitations, the last named including

angiosperms. In grouping the Metaspermæ Treub's conclusions from the study of Casuarina are accepted, and the groups Chalazagameæ and Porogameæ adopted, dependent upon the absence or presence of a micropylar canal. The Porogameæ contain monocotyledons and dicotyledons; the latter being further subdivided into Archichlamydeæ and Metachlamydeæ, the former being a combination of Polypetaleæ and Apetalæ, the latter the Gamopetalæ.

Special attention is called to the definitions of Metaspermæ and Archispermæ (Gymnospermæ), which includes our knowledge of the difference in the origin of the so-called "endosperm" in the two cases and the still somewhat obscure notions as to the sexual origin of the angiospermous "endosperm." Our present knowledge and theory with reference to these very important but very recondite distinctions are well and compactly put, but we may be pardoned the question whether the language is not too severely technical to be addressed "not to any coterie of *savants* in some special line of science, but to the general public of Minnesota." Professor MacMillan has undertaken a very interesting piece of work, and with a vigor of style and freedom from restraint that will surely bring useful results.

Minor Notices.

DR. N. L. BRITTON has published a synoptical list, including synonymy, range, and descriptions of new species and varieties of the species of Scirpus and Rhynchospora occurring in North America.[1] Of Scirpus 36 species are enumerated, including the new *S. Peckii* of N. Y. and Conn. Rhynchospora presents sixty species, sixteen of which are Mexican, West Indian, and South American.

DR. TRELEASE has long been studying our Yuccas, a sort of heritage from Dr. Engelmann, intensified by his own interest in all that relates to pollination. The story of Yucca, told by Dr. Engelmann, Professor Riley, and Dr. Trelease, is a part of the pyrotechnics of our science, so wonderful that seeing is almost necessary to believing. Dr. Trelease had intended to give to the public a summary of the whole subject, together with the results of his recent studies both in the Botanical Garden and in the native haunts of Yucca, but Professor Riley has undertaken the work from the standpoint of Pronuba. We have left, however, in the reprint before us[2], a synoptical list of our

[1] BRITTON, N. L.—A list of the species of the genera Scirpus and Rhynchospora occurring in North America. Contrib. Herb. Columbia Coll. no. 26. Reprinted from Trans. N. Y. Acad. Sci. XI, pp. 74-94.

[2] TRELEASE, WILLIAM.—Detail illustrations of Yucca and description of Agave Engelmanni. From the 3d Ann. Rep. of the Mo. Bot. Garden, pp. 159-168 with 25 full page plates. Issued May 28, 1892.

Yuccas and illustrations of thirteen of the species. Eleven plates are devoted to the display of such characters as enter into the delimitation of species, while twelve reproductions of photographs show finely the facies of the different species. A new Agave, *A. Engelmanni*, is also described and figured.

OPEN LETTERS.

Who are biologists?

Botanists will feel grateful to Prof. MacMillan for his vigorous protests against the present unfortunate attitude assumed by zoologists in regard to the position of botany as one of the biological sciences. This question is one which vexes us here as well as elsewhere, but since my connection with the University we have been insisting upon a recognition—by our students at least—of the place in biological studies to which botany is entitled, and I am glad to say that there is a disposition among some of the best of our zoologists here, to grant what we claim in this respect. The question is an important one in many ways, and it has occurred to me more than once, that it would be a proper one for action by the Botanical Club in the first instance, and then, if possible, by the Biological Section of the A. A. A. S. Certainly the botanists of the United States and Canada are a sufficiently numerous body to make any serious representations from them of value. Were action taken by them in this case, and their position firmly maintained, I think it would have considerable weight in settling once for all what is a most unnecessary annoyance and injustice to an important profession.

The Madison meeting is to be an important one. At it will be gathered, it is hoped, not only all our own best men, but a number of representative men from abroad. There could be no more fitting opportunity to bring this question forward and have it freely discussed, and the present is none too early to suggest such a movement.—D. P. PENHALLOW, *McGill University, Montreal.*

Variations of the strawberry leaf.

The article of Mrs. Kellerman in the August number of the GAZETTE suggests the following: In May, 1889, I noticed upon specimens of *Fragaria* which were brought into the laboratory, additional fourth and fifth leaflets upon the petiole below the normal leaflets. Turning to Bentham and Hooker, Genera Plantarum, under Fragaria, I found "*Folia alterna, 3-foliata, rarissime foliolis paucis lateralibus adjectis pinnata v. 1 v. 5-foliata.*" I determined to search for more examples with a view of ascertaining whether the variation was rare or common in this locality.

In June of the same year, while collecting with half-a-dozen students in the vicinity of Willmette, we all so frequently found the leaves bearing the additional leaflets that we concluded that they could be spoken of as "not uncommon in this locality." October 20, 1890, I found them plentiful at the side of the railroad north of the Ridge viaduct

in a patch of ground which may have been formerly part of a garden. Of fifty leaves taken at random twelve had extra leaflets upon the petiole. Of these twelve, eight had two leaflets, opposite in four cases and alternate in four, and four had single leaflets upon the petiole below the normal leaflets.

May 7th, 1891, I found the extra leaflets abundant in the locality just mentioned and also upon our north campus near the lake shore. When picking at random one in every four or five had the extra one or two leaflets.

In July, 1891, I found in the herbarium of the Natural History Museum, Kensington, London, two specimens of Fragaria Virginiana, one collected in Colorado and the other at Kettle Falls upon the Columbia river, which had the supernumerary lateral leaflets.

My observations tend to the conclusion that in some localities twenty per cent. of the leaves of Fragaria have five leaflets, two of which usually disappear as the season advances leaving the normal trifoliate form.

Mrs. Kellerman, from the variations which she has noted, reasons that the strawberry is developing a quinquefoliate form of leaf. By the flight of his imagination in "The Evolutionist at Large," Grant Allen shows how the "fruit" of the strawberry may have developed from a potentilla; while the facts given above seem to indicate that the plant, so far as the leaves give evidence, is passing or has passed from a pinnate form, not unlike certain potentillas, having five or more leaflets, into a trifoliate form. These observations were made both upon Fragaria Virginiana and upon its variety Illinoensis.—C. B. ATWELL, *Northwestern University, Evanston, Ills.*

NOTES AND NEWS.

MR. E. W. FISHER has been appointed curator of the herbarium of Indiana University.

A DICTIONARY of botanical terms by A. A. Crozier has recently been issued by Henry Holt & Co.

CORRECTION.—In Mr. A. F. Foerste's article in the August GAZETTE, on p. 244, Hamamelis Canadensis is mentioned twice. This was an oversight, since *H. Virginiana* was intended in both cases.

THE FOLLOWING PAPERS by Professor Pammel appear in the Proceedings of the Iowa Academy of Sciences, vol. 1, pt. 2: Woody plants of Western Wisconsin; and, Forest vegetation of the Upper Mississippi.

DR. H. L. RUSSELL, whose studies of marine bacteria and of the immunity of plants from bacterial diseases are among important recent contributions to bacteriology, has accepted a fellowship in biology in the University of Chicago.

MR. WALTER H. EVANS has been appointed by the Department of Agriculture, in the office of Experiment Stations, to have charge of the

compilation of the botanical work of the various Experiment Stations for the "Experiment Station Record."

THE ANATOMY of the stem of Wistaria has been studied by Carlton C. Curtiss, and the results published in the *Journal of the N. Y. Micr. Society* (viii, 79), and again issued as the twenty-eighth Contribution from the herbarium of Columbia College.

YEAST FREE from bacteria, molds, and other impurities, obtained by Hansen's method, has been in use in this country for three years past, according to the *American Brewers' Review*, and is likely to supersede the usual methods of preparation when required in large quantities.

A SYNOPTICAL LIST, with description, of the ferns and fern-allies of Jamaica, is being published by G. S. Jenma, Superintendent of the Botanical Gardens, Demerara, in the *Bulletin of the Botanical Department, Jamaica*. The tenth number appeared in the *Bulletin* for July The list includes many new species.

AN APPRECIATIVE notice of the life and works of Prof. Dr. Emil C. Hansen, of the Carlsberg Laboratory in Copenhagen, with portrait, appears in the *American Brewers' Review* for August 4 and 11. Dr. Hansen has greatly extended the knowledge of fermentation, and made many useful applications of his discoveries.

THE REPORT of the botanical department of the New Jersey Experiment Station for 1891 covers over a hundred pages of the fourth annual report of the Station recently issued. In this report Professor Halsted treats of a large number of fungous diseases of cultivated and wild plants and of the subject of weeds. The report is copiously illustrated.

GARDEN AND FOREST for September 21st, contains the following articles of general botanical interest: "Native shrubs of California," by Professor E. L. Greene (devoted to *Ceanothus*); "The Polemoniaceæ of the Lake Region," by E. J. Hill; and "The self-pollination of the grape," a paper read by Professor S. A. Beach at the Rochester meeting of the American Association.

PROFESSOR J. E. HUMPHREY has resigned his position as "vegetable physiologist" of the Massachusetts Agricultural Experiment Station, the resignation to take effect the first of January. After that time he will spend three or four months in Jamaica in the study of algæ and fungi. He hopes to secure some good developmental material, and to make cultures of Saprolegniaceæ, etc.

THE ENTIRE separate edition of "The Keys to Genera and Species of North American Mosses" reprinted by Prof. Barnes from vol. VIII of the "Transactions of the Wisconsin Academy of Sciences, Arts and Letters," has been disposed of. The pamphlet is therefore "out of print," and can only be obtained by purchasing the volume cited which may be had of the secretary, Dr. William H. Hobbs, Madison, Wis.

PROFESSOR L. H. PAMMEL, of Iowa Agricultural College, has distributed a sixty-page pamphlet containing the following papers: "A lecture on pollination of flowers," delivered at the State Horticultural Society, January, 1892; "Cross and self-fertilization in plants," a paper

read at the meeting of the Eastern Iowa Horticultural Society, December, 1891; and "The effects of cross-fertilization in plants," read at the meeting of the Northern Horticultural Society, December, 1891. The first paper is profusely illustrated.

THE SHRINKAGE of leaves during the process of drying for herbarium specimens has engaged the attention of Mr. E. E. Bogue, who gives measurements before and after drying in *Science* for September 16. From three to five leaves of Quercus coccinea, Arisæma triphyllum, Asimina triloba, Arctium Lappa, Asclepias Cornuti and six other common plants, were examined and found to shrink on an average of one to three-sixteenths of an inch, except the water plant, Nymphaea odorata, which shrank about an inch.

TWO INTERESTING new Uredineæ from South America are described by Dietel (*Hedwigia*, 1892, p. 159). One is a Ravenelia on Acacia, and the other is a Phragmidium on some leguminous plant. The latter merits special attention as it is the only member of the genus not parasitic on the Rosaceæ. It has been imperfectly known for a long time from material collected by Wright in Texas (Saccardo, Sylloge, vii, 749). It is also remarkable for the close agreement in the physical characters of the exospore with Uropyxis Amorphæ.

A LETTER from Prof. L. M. Underwood, delegate from the Botanical Club of the American Association to the International Botanical Congress at Genoa, announces that the attendance was large and representative. Articles I, II and III of the Berlin recommendations were adopted, except that the American suggestion prevails and 1753 was adopted as the uniform date for genera and species. Article IV and other matters were referred to a standing international committee, upon which the American representatives are N. L. Britton, J. M. Coulter and E. L. Greene.

THE FIRST and only circular of the World's Congress Auxiliary relating to botany, which was prepared last May, and should have been mailed from the Chicago office June 1, has been tardily distributed since the September number of the GAZETTE went to press. The chief design of the circular was to obtain the opinion of the botanists of the country upon the feasibility of holding a botanical congress in connection with the Columbian Exposition. The belated appearance of the circular has deprived it of all value, as the botanists at Rochester, acting as a representive body, decided unanimously that a congress under such auspices was not advisable, but that instead one should be held in connection with the meeting of the A. A. A. S. next year in Madison. This will doubtless be done, whatever replies are sent to the circular.

THE CONTRIBUTIONS from the Herbarium of Columbia College are multiplying rapidly. No. 27 is entitled "Note on a collection of Tertiary fossil plants from Potosi, Bolivia," by N. L. Britton. It contains descriptions of some eighteen species, illustrated by three plates. Eleven of the species are new. No. 28 is upon "The anatomy of the stem of *Wistaria Sinensis*," by Carlton C. Curtiss, illustrated by three plates. No. 29 is the sixth bearing the title "New or noteworthy North American phanerogams," by N. L. Britton. Among other notes a new

eastern *Cardamine* is separated from among other forms; the var. *mollis* of *Agrimonia Eupatoria* is raised to specific rank, as is also the var. *Americana* of *Fragaria vesca*; a new *Polemonium* of the North Atlantic states is described and figured; also a new *Phlox* from Montana and Dakota.

AT HIS OWN request Prof. C R. Barnes has been relieved of revising Gray's "Field, Forest and Garden Botany." The prescribed limitations of space and the ever increasing number of species of cultivated and native plants which it seemed necessary to include proved irreconcilable. His feeling that he could not, under the conditions imposed, make a work satisfactory to himself, led Prof. Barnes to abandon the task. It has now been put into the hands of Prof. L. H. Bailey, whose extensive familiarity with the plants of our fields, forests and gardens will insure a careful and thorough revision. A tentative list of the species to be included, involving a considerable study of the nomenclature of cultivated plants, together with the first draft of the manuscript through Leguminosæ have been placed in Prof. Bailey's hands for such use as he may see fit to make of them.

TWO HUNDRED and forty dollars have been placed at the disposal of the American Microscopical society, to be given as prizes for the encouragement of microscopical research, and Profs. S. H. Gage, of Ithaca, N. Y., D. S. Kellicott, of Columbus, O., and W. H. Seaman, of Washington, D. C., were appointed a committee to prepare the conditions on which they should be granted. The competition will be open to members of the society and to those who make application for membership, before submitting their papers to the committee, which has prescribed the following conditions:

One prize of fifty dollars is offered for the best paper which shall give the results of an original investigation made with the microscope and relating to *plant* life, not less than 3,000 words in length. The methods by which the results were obtained must be given in full. A similar prize for an investigation relating to *animal* life.

Two prizes of twenty-five dollars each will be given for the second best papers on plant and animal life, respectively, on the above conditions.

The papers, drawings and specimens entered for the above prizes are to be submitted to the committee on or before July 1st, 1893, and the papers and drawings will be published in the Proceedings.

One prize of thirty dollars is offered for the best six photomicrographs on some subject in animal or vegetable histology, and another of the same amount for the best collection of six mounted slides illustrating some one biological subject.

There are also two prizes of fifteen dollars each for the second best collection of photomicrographs and slides respectively.

The object of these prizes is to stimulate and encourage original investigation in the biology of North America.

Additional information as to the conditions may be obtained of the committee on prizes.

BOTANICAL GAZETTE

NOVEMBER, 1892.

The International Congress at Genoa.

LUCIEN M. UNDERWOOD.

It may not be without interest to the botanists of America to know something of the Botanical Congress which assembled in Genoa September 4–11. In fact I feel it my duty to my colleagues, who conferred on me the honor of being their representative, to give at this earliest possible opportunity a somewhat detailed account of the meeting and its results. I will present here some of the general items of the journey, reserving for another place[1] an account of the discussion of the nomenclature problem.

A trip to Europe cannot properly be arranged for with two days notice. Yet my appointment as delegate from the Botanical Club of the A. A. A. S. was made on Monday, August 22d, and as the Congress opened Sunday, September 4th, my only chance of reaching Genoa at the opening session was to sail from New York Wednesday, August 24th, by the *Majestic* of the White Star Line. Returning by the first available steamer (on account of the present crowded condition of travel) I was even then over three weeks late with my lectures. It will thus be seen that the trip has been taken with some inconvenience to myself and sacrifice on the part of others.

At New York I met Dr. Vasey, who represented the Smithsonian Institution, and we proceeded together to Genoa, remained together most of the time, and returned together. We reached Genoa from Liverpool by the shortest route (*via* Mont Cenis) just after dark on Saturday, September 3d.

The opening reception at Genoa was held at the grand hall of the Municipio, and was, like all the receptions, decidedly informal. A few at the opening session of the Congress on the following day, mistaking the occasion, appeared in full

[1]This paper, bearing even date with the present, I send to the *Bulletin of the Torrey Botanical Club*.

dress, but after maintaining a self-appointed conspicuity for a single session, reappeared in the afternoon clothed and in their right minds.

The moving spirit in the management of the Congress was Professor Penzig. In his capacity of general secretary he was the life of the entire Congress. Readily speaking four languages, of infinite patience, always cheerful, and even at times overflowing with good spirits, he conducted the affairs of the Congress in a manner that won him the admiration of every one in attendance. His tall gaunt form was everywhere, making strangers at home, answering the multitudinous detail of annoying questions, now attending to routine, now reading papers before the Congress, now carrying out the complicated business details of the excursions, unruffled, ubiquitous, urbane—the very soul of good nature, and a prince in management.

While the official language of the Congress was Italian, none of the presiding officers used it, and it would be difficult to say whether Italian, French or German predominated; in the heat of discussion the polyglot approximated the Babel of tongues. The soft, rhythmic cadences of the expressive Italian were followed by the earnest but often harsh tones of the deep, soul-stirring German; the suave nasals of the polished French succeeded the blunt but copious and effective English. Never were we more happily disappointed in the apparent strength of a spoken language, as compared with its seemingly weak terminations in print, than we were in listening to the Italian. Never were we so impressed with the necessity of a common language for scientific intercourse; never more convinced that English will ultimately be that chosen language.

At the opening of the scientific sessions which were held in the grand hall of the University[2] Thomas Hanbury was made the honorary president of the sessions. There were thirty-six vice presidents of whom Ascherson, Burnat, Bonnet, Borodin, Chodat, Durand, Haussknecht, Kny, Magnus, Magnin, Moore, Prantl, Pfitzer, Radlkofer, Strasburger, Underwood, Vasey, Vilmorin, Marshall-Ward and Wright were present. The ballot among the vice presidents for the first

[2]Founded as a Jesuit College, 1623; university organization established in 1812.

presiding officer led to a very close count between Penzig and Strasburger, the latter attaining the position by a majority of one. The further sessions were presided over in order by Vasey, Vilmorin, Borodin, Marshall-Ward, Burnat, and Durand, each using his native speech except Strasburger and Borodin who used French.

The number of delegates in actual attendance is a difficult question to determine. A list of members of the Congress was published and early distributed, but this included several who had expected to be present but were unfortunately detained. Of the 196 names published in the list we know of at least 28 who were not present; among these were Cohn, von Thümen, Brefeld, N. L. Britton, Bailey-Balfour, Malinvaud and Thistleton-Dyer.

The members of the list (of whom we personally met 62) were divided among the various nationalities as follows: Italy 108, Germany 25, France 13, Great Britain 12 (of whom only six were present), Austro-Hungary 9, United States 6 (of whom three were present), Switzerland 4, Belgium 3, Scandinavia 3 (of whom only one was present), Russia, Spain and Turkey each one. Ten others were distributed from Mexico and Cuba to Mauritius and New Zealand, but none of these were present. The actual attendance, limited mainly to members of the Congress, probably ranged from 100 to 150 Among the better known Italian botanists present were Penzig, Saccardo, Massalongo, De Toni, Arcangeli, Berlese, Caruel, Cavara, Delpino, St. Sommier, Martelli, and others. Among the Germans were Ascherson, Kny, Klein, Magnus, Prantl, Pfitzer, Radlkofer, Strasburger, and Haussknecht. Vilmorin, Burnat and Bonnet represented France; Chodat, Switzerland; Durand, Belgium; and Borodin, Russia. Marshall-Ward was the leader of the British delegation which was equally divided between the English and Irish botanists. In addition to Dr. Vasey and myself, America was represented by Prof. Henrietta Hooker of Mt. Holyoke College, the only educational institution that sent a delegate to the Congress. Mt. Holyoke was further represented by two of the graduates from its botánical laboratory, Miss Catharine Barbour, of San Sebastian, Spain, and Miss Arma Smith, of Constantinople, who are pioneer botanical missionaries from the new world to the botanically less-known regions of the old, and

are carrying American methods to the slower and more conservative nations of Europe.

Each delegate was presented with a card of membership and an elaborate button-hole badge with the inscription "Congresso Internazionale Botanico Genova 1892" in black letters on a gilt border, and with the arms of Genoa, including the red cross of Savoy, in gilt on a white field.[3] We were also given a guide to Genoa which was a special edition of a well known German guide[4] bound, with coupons and stubs for our various excursions and entertainments, in a special board cover labeled in true German style "Congresso Botanico Jnternazionale."

The session of Monday forenoon was given up largely to the formalities of opening the Congress, the addresses of welcome by Arcangeli, President of the *Societa Botanica Italiana*, and others, the election of presiding officer for the afternoon session, the greeting from Strasburger, presiding officer elect, and general notices for the sessions and excursions. On Monday afternoon the reading of papers was taken up, commencing with one by Strasburger "Ueber Schwärmsporen, Gameten, Spermatozoiden und die Befruchtung," followed by others by Saccardo, Massalongo, and Arcangeli. Opportunity for discussion was given after each paper and some elicited considerable spirit and enthusiasm. During the congress forty-three papers were read by thirty-two persons. Of these papers twenty-five were by Italians, seven by French, six by Germans, two by Swiss, two by Russian and one by Belgian botanists, covering a wide range as will be seen from a few selected topics: "Sopra alcuni entomocecidii Italiani." "Sur l'électricité statique et son action sur la vegetation." "Zur physiologischen Bedeutung des Anthocyans." "Sur les dépots diffus d'oxalate de chaux dans les feuilles." "Zum Schutz des Edelweiss." "Note teratologiche sui fiori di alcune Orchidee indigene." "Ricerche sul nucleo e le cellule sessuali presso le piante crittogame.

On Tuesday morning the Hanbury Botanical Institute was formally dedicated. This was a gift from Mr. Thomas Hanbury of Mortola to the University of Genoa and completes a

---

[3]Our own Botanical Section might well take an idea from this and provide a permanent badge that could be worn at the A. A. A. S. meetings each year in place of the curling ribbons.

[4]Bruckmann, Villes et paysages du monde entier. No. 18, Munich.

very superior equipment for purposes of botanical instruction and research. Genoa "la superba," forms a crescent about the harbor and extends up the steep slopes of the foot hills that come down almost to the sea. From the upper story of the University one goes across a passage-way to the lower terraces of an extensive botanic garden where a diverse collection of plants has long been under cultivation. Passing to the upper terraces of the garden we come finally to a broad plateau, whence one can look over the blue Mediterranean and along the olive-crowned slopes of the Ligurian coast, hazy in the mellow Italian sunshine. On this plateau is the Hanbury Institute, now presided over by Professor Penzig, the able successor of Guiseppe De Notaris. Mr. Hanbury, a wealthy Englishman who spends his winters at his extensive Italian garden, has liberally endowed this institute and equipped its laboratories for anatomical and physiological work and has greatly extended its herbarium and enlarged its museum, making it in every respect a model for botanical instruction. The exercises were simple but impressive and ended with the unveiling of an admirable and life-like bronze of Mr. Hanbury. Following these exercises the Congress was twice grouped in the garden and photographed. The afternoon session of Tuesday was presided over by Dr. Vasey, who opened with a graceful speech in which, as the representative from the Smithsonian Institution, he touchingly alluded to the grave of Smithson in the English cemetery just outside the city of Genoa, and briefly set forth the present state of botanical research and development in America. Then followed Professor Ascherson's paper, "Sur la reforme de la nomenclature botanique,' in which he presented essentially the substance of his recently published paper.[5] After this we presented the Rochester platform and the remainder of the session was taken up with the discussion of the nomenclature problem, ending with the approval of I, II and III of the Berlin propositions with the substitution in the first of the date 1753 for both genera and species, and the appointment of a standing committee to whom all other nomenclatural problems were to be referred.[6]

[5] Berichte der deutschen botanischen Gesellschaft, x, 327—359.

[6] As some who read this may not see the full account in the *Bulletin of the Torrey Botanical Club*, it may be well to add here that the American members of this committee are Dr. Britton, of New York, Dr. J M. Coulter, of Indiana, and Prof. Greene, of California.

Wednesday was given up to a most enjoyable excursion, first by sea to Portofino, then by carriages to Santa Margherita, where a reception with wine and lunch was furnished in the Municipio, after which we were taken to the Gran Hotel on the hill overlooking the sea, where an elaborate collation was served, after which toasts were drank and responded to in truly continental style. The carriages then took us to Rapallo, where we were again wined, and mutual toasts were indulged in at the Municipio by the city officials and the visiting guests. We then proceeded to Recco, where we were obliged to decline a third entertainment for lack of time. From Recco we took the train to Genoa. The country at this time seemed dry, and botanically uninteresting, in landscape, haze and vegetation reminding one of central California during the dry season. A few straggling spermaphytes were in flower by the wayside, a *Selaginella* grew in profusion in a damp ditch, two or three ferns, mostly shriveled by the drought, appeared on the walls which bordered the streets; among them we recognized *Asplenium trichomanes*, *Ceterach officinarum* and *Adiantum capillus-veneris*, the latter more common at the watering places, where a few hepatics also maintained a doubtful existence. On shaded walls were a few mosses, and under the chestnut trees two or three agarics and boleti were growing. Orchards and vineyards, olive groves and chestnut trees made up the bulk of the cultivated vegetation, though oaks, poplars and chestnuts served for shade trees, and some lemons were in cultivation in gardens. The hills were bare of native forests, the harvest was mainly gathered and the soft haze of the golden sunshine betokened the beginning of the season of rest.

On Thursday morning the reading of papers was resumed. While giving the daily notices Prof. Penzig announced the gift to the Institute of an elaborate two-volume folio of illustrations of the plants of the region drawn and colored by hand by a Capuchin monk, who was present *in propria persona* and rose while the notice was being given. As King Humbert and Queen Margherita made a visit to Genoa and the Columbian exposition during the week of the Congress, Thursday afternoon, on which the king arrived by sea, was given up to the royal festivities. The vice-presidents were

further honored by invitations to the royal ball, which was held on Friday night.

As the Palazzo Reale was almost opposite the university, the sessions of Friday were somewhat interrupted by the clamors of the people in the narrow street for the recognition of the king. The day was almost wholly given up to the completion of the papers of the printed program, several of which were read only in abstract; some routine work of committees was attended to, and Prof. Penzig presented each visiting delegate with a representative and carefully selected fascicle of the flora of upper Italy, neatly prepared and marked in silvered letters:

Congresso Internazionale Botanico,

Genova,

1892.

O. PENZIG.

Selectæ Stirpes Liguriæ.

On Saturday an excursion was taken to Ventimiglia, a city of the Mediterranean coast, not far from Nice, and thence to Mortola, where Mr. Hanbury owns one of the most elaborate private gardens of the whole Mediterranean region. This over, the Congress was informally adjourned.

Were we called upon to suggest any changes of program or method for a gathering of botanists even more successful than this, we would say (1) reduce the number of papers read, (2) introduce a few topics for discussion that would command universal attention, (3) increase the facilities for personal and social intercourse among the members. The grand object of such a meeting is to facilitate the personal acquaintance of members and the discussion of questions of general interest, rather than stiff formality and the presentation and discussion of local questions. Every effort to secure these two ends should be most carefully studied.

De Pauw University, Greencastle, Ind.

Some new North American plants. I.

JOHN M. COULTER AND E. M. FISHER.

Heuchera Hapemani, n. sp. Stem short and slender (10 to 22 cm. high), densely glandular above, with rather few leaves, from a slender running rootstock: leaves (both radical and cauline) round-reniform (3 to 3.5 cm. broad), thin, glabrous, deeply 7 to 9 lobed (lobes dentate, with a linear gland in the sinuses), on slender grooved petioles: panicle loose and racemose; bracts and bractlets small and foliaceous: flowers on pedicels much shorter than the calyx, which is turbinate, 4 to 5 mm. long, the thin acute lobes one-third as long as the ovary: petals white (often purplish), entire, short clawed, 3 mm. long: stamens included, with very small anthers.—Big Horn Mountains, Wyoming, *Dr. H. Hapeman*, who says "the plants grew at the base of a cliff, near the water, in dark places. They follow the cracks in the rock by a slender running rootstocks." The species belongs to the group containing *H. Hallii*, but its leafy stem, deeply lobed and dentate (neither bristly nor ciliate) reniform leaves, narrower and pointed calyx-lobes, much longer and ovate short clawed petals, and its very small stamens, are characters which distinctly separate it.

BOERHAAVIA ANISOPHYLLA Gray, var. **paniculata** n. var. —As compared with the type, this plant has larger and very diffuse panicles, smaller flowers mostly solitary at the extremity of the branchlets, calyx pubescent along the ribs, and purplish pubescent fruit (4 mm. long) rugose between the ribs.—Chenate Mountains (*Nealley* 405).

Abronia Suksdorfii, n. sp.—More or less viscid-pubescent: stem erect, 4 dm. high from a perennial base: leaves obtuse, elliptical-ovate or oblong-oval, slightly rounded at base: peduncles 8 to 15 cm. long (twice longer than the leaves): bracts 5, white-scarious, linear-lanceolate (8 mm. long), acute, subtending 8 to 16 slender flowers: perianth greenish-white, the lobes obcordate: fruit indurated, broader than long, with 5 broad wings which are neither reticulated nor crested.—Sandy grounds near Columbus, Klickitat Co., Washington, June 11, 1886, *W. N. Suksdorf.* Distributed as *A. mellifera* Dougl. The species cannot be grouped with *A. mellifera*, as the wings are double and very coriaceous. The relationship

is nearest to *A. fragrans*, but the narrow involucral bracts and the broader and more coriaceous wing, with no reticulations, seem well to separate it.

Abronia Carletoni, n. sp.—Stems procumbent, slender, whitish, minutely glandular, 2.5 to 4 dm. long: leaves very thick, linear-oblong or oblong-ovate, with cuneate base and revolute margins: peduncles very slender, as long as the leaves: involucral bracts 5, rose-color, oblong-lanceolate, attenuate or cuspidate, 6 mm. long: flowers numerous: perianth rose-color, with obcordate lobes: fruit longer than broad, scarcely coriaceous, with the 5 wings coarsely reticulated and terminating above in disks.—E. Colorado, *Prof. M. A. Carleton* 459, 1891. Most closely related to *A. turbinata* Torr., having the coriaceous double wing of the section, but differing from that species in having slender white glabrous (but minutely glandular) stems, more numerous flowers, broader rose-colored attenuate or cuspidate bracts, and the perianth and its lobes not so deeply cut.

Gomphrena Pringlei, n. sp.—Low, procumbent, strigose-pubescent, from a long filiform root: stems many, rose-color, di- or trichotomously branched, 5 to 7 cm. long: leaves half-clasping, oblong-lanceolate, mucronulate, 1-nerved, 1 to 1.5 cm. long: heads many, globose, dense, white (slightly rose-tinted), 5 to 8 mm. long, subtended by 3 or 4 leaves; the denticulate long-acuminate bracts equalling the keeled and broadly crested (dentate) acute bractlets: sepals woolly, cleft to near the base (the segments linear, acute), shorter than the bractlet: stamen-tube united to the top, with linear-oblong exserted anthers: stigmas 2, recurved, together with ovary and style equalling the stamen-tube.—*Pringle* 3152, of the state of Mexico, distributed as *G. decumbens* Jacq. Very different from any described Gomphrena. The flowers and bractlets are somewhat similar to those of *G. tuberifera*, while the very short and procumbent branches seem to relate it to *G. decumbens*.

Gomphrena Nealleyi, n. sp.—Ascending, 14 to 20 cm. high, loosely long-villous, from a fusiform root: leaves spatulate, mucronulate, glabrate above, half-clasping, 3 to 3.5 cm. long; the upper ovate and much smaller: peduncle terminal, about 9 to 11 cm. long: heads rose-tinted, sessile, dense, oblong-obovate, 2 cm. or more long, subtended by two larger leaves:

flowers 5 mm. long: bracts ovate, acute, half as long as the keeled and slightly crested acute bractlets: sepals linear-lanceolate, slightly cleft, densely woolly below, little shorter than the bractlets: stamen-tube united to the top, with linear-oblong exserted anthers: stigmas, 2, minute, spreading.—Corpus Christi, Texas. *Nealley* 420, referred to *G. nitida* Roth. in Contr. Nat. Herb. I. 48. In general appearance this species simulates *G. decumbens*, but the subsessile stigmas place it in an entirely different section.

Frœlichia Texana, n. sp.— Erect, silky-villous, 5 dm. or more high, sparingly branched from a perennial base: leaves usually obtuse and mucronate, farinose, whitish and densely silky below; the radical spatulate, 8 to 9 cm long, tapering to a slender petiole; the cauline short-petioled or subsessile, oblong or elliptical-ovate, 2.5 to 3.5 cm. long: peduncles terminal, the spikes 3cm. long, lengthening and becoming scattered in age: flowers 5mm. long, with thin bracts and bractlets, the latter very broad and deeply concave: fruiting calyx fuscous, cordate, flat on one side, the wings pale, broad, crenate.—Pena, Western Texas. *Nealley* 521, referred to *F. Floridana* Moq. in Contr. Nat. Herb. I.48. The species most nearly resembles *F. Floridana*, but differs in its elliptical-ovate leaves, very broad and deeply curved bractlets, and cordate fruiting calyx (flat on one side) with pale crenate wings.

Eriogonum Texanum, n. sp.—A stout subtomentose perennial, about 6 dm. high, simple, woody below. naked above: leaves very coriaceous, linear-lanceolate, 7 to 10 cm. long, tapering below to a short clasping petiole, densely tomentose beneath, silky-villous above: inflorescence twice or thrice di- or trichotomous, with divaricate branches: involucre solitary, sessile, coriaceous, 5 to 7 mm. long, with five short and round teeth: flowers yellowish, on long pedicels, densely silky-villous, 7 to 8mm. long: perianth segments similar, oblong-lanceolate, thickish, with rugose margins —W. Texas, *Nealley*, 1890. This species belongs to § OREGONIUM, and seems to be unlike all others in the very coriaceous texture of the leaves and inflorescence, the former with a very prominent midrib. The very thick involucre is strongly nerved (as seen within), its teeth tipped with a short mucro, and the central ones are short pedunculate.

Eriogonum Pringlei, n. sp.—Woody, 3 dm. high, densely white tomentose, leafy throughout, with flaky bark, and many slender intricate branches above, each terminated by a loose paniculate spike (4 to 6 cm. long), leaves linear, acute, very small (1 cm. long,) narrower toward the base, strongly revolute, often with smaller ones fascicled at the base of the branchlets: bracts very small, triangular to setaceous: involucres sessile, small (2 cm. long), 6 to 9, regularly distributed, each containing 4 or 5 minute whitish or slightly rose-colored flowers (2 mm. long).—Rocky hills near Maricopa, Arizona, *Pringle*, in 1882, and distributed as "*E. Wrightii* Torr., var., or a new species." It is nearest to *E. Wrightii* Torr., but its flaky bark, many intricate branchlets, short linear revolute leaves, numerous spikelets with smaller and regularly arranged involucres and flowers, narrower and lighter colored sepals, and smooth achenes make it a very distinct species.

Euphorbia Nealleyi, n. sp.—Densely puberulent throughout; stems slender, erect or ascending (2 to 3 dm. high), branched or simple at the woody base, with few alternate branches above: leaves opposite, linear, (2 to 3 cm. long, 1 to 1.5 mm. wide), entire, short-petioled, thickish, acute, cuspidate; glandular stipules minute: involucres solitary, axillary and terminal, pedunculate, turbinate; glands 4, transversely oblong, with large and white irregularly dentate truncate appendages: style short: pod rather depressed, about 3 mm. broad: seed ovate-triangular, deeply and irregularly transverse sulcate.—W. Texas (*Nealley*, 1890). This species belongs to § ALECTEROCTONUM except the leaves are simply opposite and not ternate or verticillate. Its general appearance is that of *E. biformis* Watson, but its stems are alternately branched and its seeds are strongly sulcate. It really seems to be somewhat intermediate between the sections Alecteroctonum and Zygophyllidium.

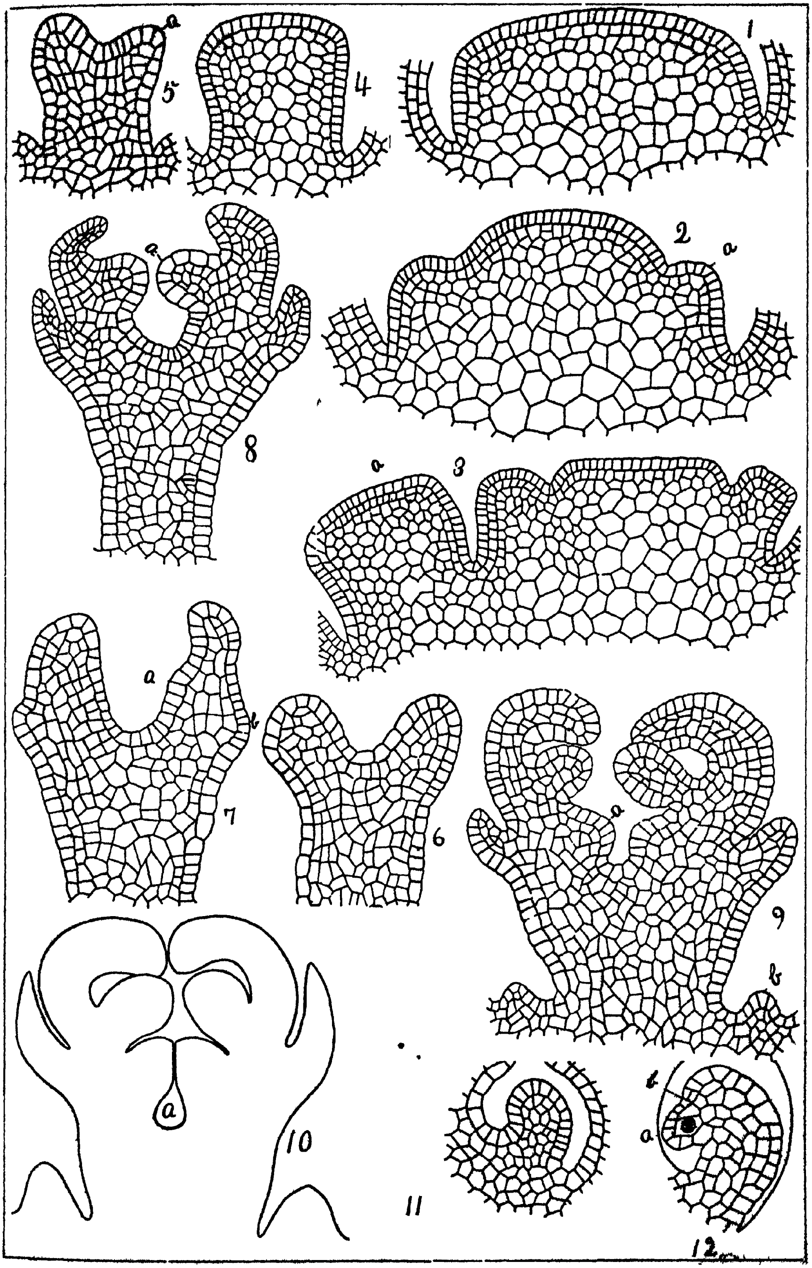
Ricinella Vaseyi (Coulter.) *Euphorbia Vaseyi* Coulter, Contr. U. S. Nat. Herb. I, 48. Since the publication of this species additional material and information have come to hand, which make it evident that it must be referred to *Ricinella* (*Adelia.*) In addition to the characters given in the contribution referred to the following may be added: The plant is a diœcious shrub, 15 to 18 dm. high, with several

straight branches from the root. The staminate flowers have five sepals and ten stamens, and fall off at once when touched. The species is most nearly related to the West Indian *Ricinella pedunculosa* Muell. (*Adelia Ricinella*), but its simple long stems (branched at base,) small coriaceous to three nerved narrowly obovate non-punctate leaves (not shining above), single and short (1.5 cm.) fruiting pedicel, and much larger angulate seed with prominent hilum, make it a very distinct species. From Brazos Santiago and Booneville, Texas (*Nealley*).

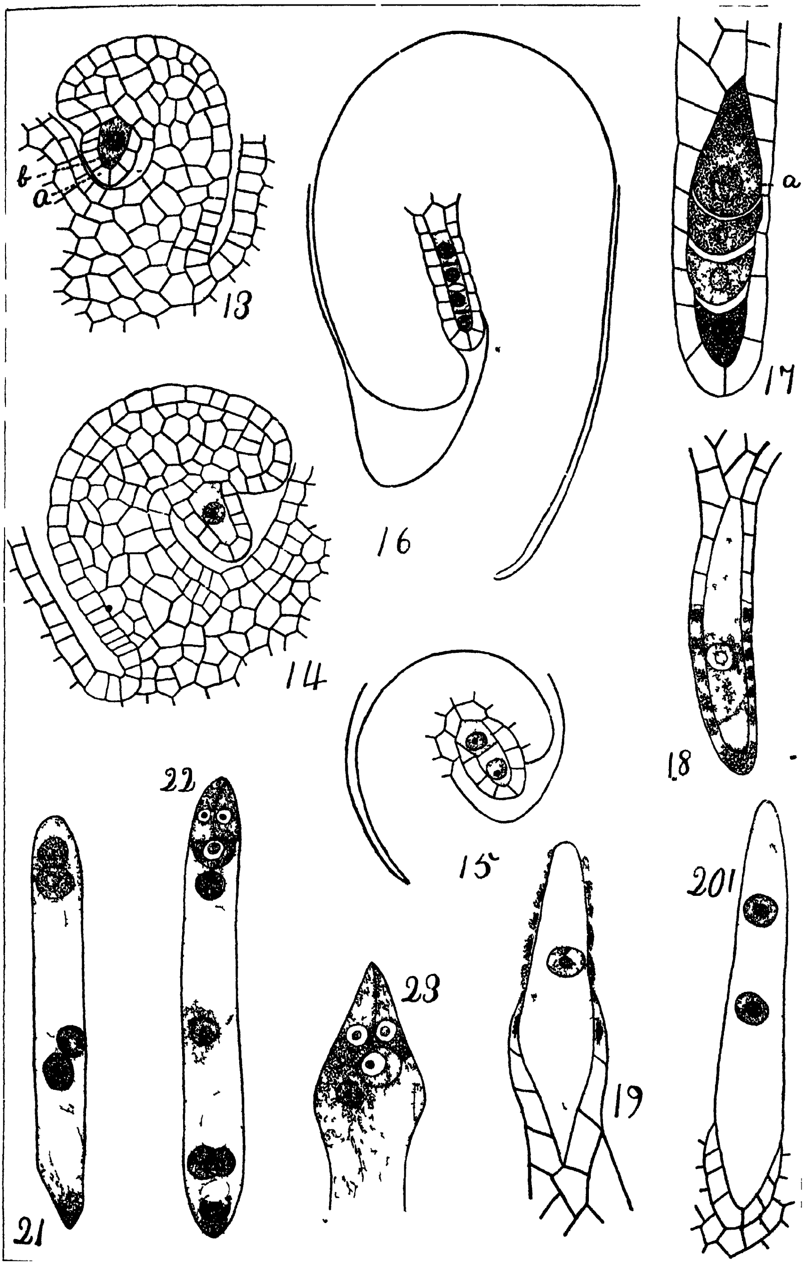
Sisyrinchium Thurowi, n. sp. Low (4 to 7 cm. high), cespitose and procumbent: stems rather broadly winged, with a flower-bearing branch at each node: leaves short, scarcely 2 mm. broad: corolla 4 to 5 mm. long: outer bracts a little longer than the very slender pedicels: flowers small, yellow, 2 to 4 in each umbel: pods oblong or pear shaped (4 to 5 mm. long), prominently transversely wrinkled between the seeds, which are 10 to 14 in each cell, depressed-globose, very small (scarcely 0.5 mm. broad), black and deeply punctate. —Hockley, Texas, *Thurow*. Nearest *S. Schaffneri* Wats., but smaller, densely cespitose and procumbent, not at all scapose (the stems bearing leaves and flowering branches), with smaller leaves, smaller, firmer and more deeply wrinkled pods, and very minute black punctate seeds.

Fritillaria linearis, n. sp. Bulb scales few and thick: stem 20 to 25 cm. high: leaves (10 or more) narrowly linear-lanceolate, scattered, more or less whorled below: flowers 2, blotched with brownish purple within, 2 cm. long, the segments ovate-lanceolate, slightly spreading at the tips, much longer than the style, which is deeply parted and much longer than the stamens.—Black Hills of Dakota. In some way the name of the collector has been lost. The species is nearest *F. biflora*, but is much lower, leafy throughout with linear leaves, ovate-lanceolate lighter colored perianth segments, and much smaller stamens on filaments much shorter than the deeply parted styles.

Indiana University, Bloomington.



MARTIN on ASTER and SOLIDAGO.



MARTIN on ASTER and SOLIDAGO

Development of the flower and embryo-sac in Aster and Solidago.

G. W. MARTIN.

(WITH PLATES XIX AND XX.)

Before entering directly upon the subject it may be well to recount the primitive conditions of the leaf-shoot and its growing point as found in Compositæ. The point of growth of the shoot-axis becomes very much retarded, and as a result, the growing-point is transformed into a broad, somewhat elevated disc, on which are to appear flowering capitula with centripetal inflorescence (fig. 1). The first structure indicating an individual, embryonic flower on the receptacle is a hemispherical outgrowth almost perfect in outline, and becoming obconical as growth takes place (figs. 2a and 3a).[1] This embryonic tissue, standing on a lateral axis, constitutes the foundation from which arises a differentiation of tissue into special organs (fig. 4). Thus far the path of embryonic development remains the same for all organs, even those of the most various kinds. From this condition of things on a new departure is made; the apex of the broad flower-axis ceases to grow, while the peripheral portion continues to develop; and here we have the first hint of the initial growth of true floral organs (fig. 5). A tubular ring is thus formed, and on its peripheral wall small papillæ arise, giving the structure a cup-shaped appearance with a shallow depression and scalloped margin (fig. 5a). This so-called cup elongates; its sinus grows deeper, and the five corolla lobes become sharply defined and are known at once by their shape (fig. 6). Simultaneously with the development of the floral organs in the rising ring, in which there is a complete fusion of all flower parts till liberated a deep, central depression is forming, when ultimately the ovule-bearing portion is placed beneath the rest of the flower-parts (figs. 6–10). Thus we have an epigynous flower with an inferior ovary.[2] However, there are some who would substitute the word hypogynous for epigynous, basing their argument on the theory that all the floral organs in their initial state are coalesced in the annular

[1] Just here may be stated that this rudimentary, sessile floret is the firstindication of plant subdivision.

[2] Gray's Structural Botany, p. 183.

wall; that the appearance of each is due to the liberation of their uppermost parts; that each whorl may appear either in acropetal or certain whorls seemingly in basipetal order.[8] The real origin and behavior of the floral organs in their younger stages of development as correlated with the inferior ovary has attracted but little attention, and therefore, no definite statement can be made as to the true relationship existing between the floral organs in their embryonic condition.

Turning now to the order of development of flower parts, the first foliar structure that appears is a petal. At first they appear as small papillæ on the annular wall (fig. 5a). In their further development the tissue thickens and the epidermal cells with their rather heavy cell walls become quite large; in later growth the tissue becomes more uniform, and the tips of the five marginal teeth of the corolla-tube turn inward, thus furnishing a splendid protection to the andrœcium and gynæcium (figs. 7–10). The petals forming the flower tube are not simply contiguous but united, and as the tube elongates it assumes the form of a funnel whose upper margin has five spreading teeth. The tubular corolla is not composed of parts originally separate and subsequently united by their lateral margins; for the parts set free are the marginal teeth arising from a common, basal tissue; and this tissue develops and elongates *pari passu* with the growth of the nascent organs within.

Almost immediately following the visible corolla, appearing on its inner basal margin, are five minute elevations, the rudimentary stamens (fig. 7a). These develop with remarkable rapidity, and their primitive oval form is soon exchanged for one that is oblong (fig. 8a). The histological structure of the stamen in its early growth is a mass of uniform parenchyma. Presently a new condition arises; a differentiation of tissue into anther-lobes and a connective takes place. The fibro-vascular bundle, which is a continuation of that of the flower-axis, though very much reduced, differentiates in the upper part of the stamen and forms the so-called connective. At the same time there is a modification of tissue which develops into anther-lobes; these are connected and yet separated by the connective. In the early process of growth there appear two longitudinal ridges

[8] Coulter on the Dandelion, Amer. Naturalist, xvii, No. 12, p. 1212.

on each half-anther-lobe; these answer to the future pollen-sacs, and give rise to the archesporium cells, which, usually having but one row of cells in each pollen-sac, again give rise to the squarish mother-cells; in turn the latter yield four pollen grains each. The developmental path pursued by all pollen grains is so common that it needs no special description. To give a more complete account of stamineal tissue, mention also should be made of the anther-tube. At first the filament develops slowly and the stamens are distinct from one another, but just preceding the unfolding of the flower-bud the filament gains length at a very rapid rate by the elongation of its cells; finally, the lateral margins of the anthers become coalescent, thus forming a tube, which, when the flower is fully developed, projects beyond the tubular-corolla. The anthers do not simply cohere but unite, for cross-sections show the blending of epidermal tissue; this makes the union complete. Simultaneously with the origin and development of the stamen another structure comes into view, the calyx (fig. 7b). When first observed there is a bulging-out of the epidermal layer in the region of the seeming insertion of the other floral parts. The tube of this outgrowth is not distinguishable from the ovarian wall, but its limb is visible as a tuft of hairs. Primitively, it consists of a short delicate bunch of hairs, arranged in a circle at the upper extremity of the young ovary. Later, the hairs by rapid growth develop into long appendages, made up of several rows of narrow but extremely elongated cells, the lower ends of which splice into the upper ends of the cells below at the point where the upper end of the cell below turns away from the main trunk, and rapidly tapers into an acuminate tip; hence, the hair has the appearance of a barbed spear. By its late appearance in development, and its epidermal structure, some do not regard pappus as a calyx, while on the other hand others so consider it, though very much reduced in form and structure, caused by the pressure of surrounding parts.

A little previous to the formation of the pistil another structure may be seen to arise from the receptacle between the individual florets (fig. 9b). These foliar bodies, or bracteoles, very much resemble the scale-like leaves of poorly developed vegetative branches. They project quite far between

the individual flowers. Their epidermal tissue consists of very thick walled, elongated cells surrounding several layers of smaller parenchyma cells.

The next and last set of floral organs to appear is the pistil. About the time when the stamens begin to assume an oval outline and form a constriction near their bases, thereby separating the stamineal tissue into anther and filament, there is detected on the inner border of the primitive ring, in the region of stamineal insertion, an inward growth of cells (fig. 9a). This cell tissue gradually develops inward around a common axis till all sides meet, and at the same time elongates in the direction of the flower axis, thus forming the style above, and completely overarching the once oval cavity below, changing it into a flask-shaped cavity which is the true ovarian cell (fig. 10a). Just at this stage of development it may be mentioned that from now on, the flower parts develop with remarkable rapidity, and finally the flower axis is very much elongated, the gynœcium forming the terminal structure of the flower, The growth of the pistil is somewhat analogous to that of the stamen. As before stated, stamineal growth is partially retarded up to a certain point, from whence it makes rapid strides by the elongation of the cells of the filament; and for a time the stamen crowns the summit of the flower. So there is a similar phase of growth which characterizes the style; there is a slight cessation of its growth until the anthers begin to shed their pollen, when the style by rapid development pushes its way up through the syngenesious stamens. The lengthening of the style is due to the growth and elongation of the carpellary cells above the ovary. In this case is found a good example of protandry, which suggests cross-pollination. After the opening of the flower, the style lengthens and the pollen is pushed out of the anther-tube by the brush-like upper portion of the style as the anthers dehisce. The lines of the stigmatic receptive surfaces remain intact till that portion of the two-branched style is shoved above the anther-tube, whence the two branches separate, curving far back, and expose the stigmatic papillæ on their inner faces; thus the style is made the instrument for disseminating the pollen which it cannot use for itself; as a result, cross-pollination, with almost absolute certainty, is insured. To speak further of the two-branched style: Two kinds of

hairs are detected; these comprise stigmatic papillæ and brush hairs. The former are usually short, being either acutely or obtusely tipped, and are confined to the inner faces of the style-branches. The latter are cylindrical, epidermal outgrowths, having various arrangements both on the inner and outer faces of the style-branches. In the *Aster* the style-branches are flattened, and linear from their bases to the ends of the two lines of papillæ which line each stigmatic surface. Above the termination of the stigmatic lines are seen brush hairs which cover both faces of the style branches. In the *Solidago* the style-branches very much resemble in outline those of the *Aster*. Two stigmatic lines are observed which extend from the base of the branch to a point about one-half the distance to its tip. The brush hairs usually cover the whole outer surface of the branch, and the edges and the tip of the inner face above the termination of the stigmatic lines.

It yet remains to speak of the tissue and its modifications that make up the structure of the style. It consists, chiefly, of ordinary parenchyma, the central portion of which is modified, while the upper stigmatic portion is a differentiation of the epidermis into a soft mucilaginous tissue, thus forming a loose conducting mass for the penetration of the pollen-tube.[4] In the center of the conducting tissue is also seen a very narrow tubular opening, indicating that it is a continuation of the ovarian cavity. This seems to be constant throughout the species examined. Before concluding, however, the description of the different floral organs, let the following order of succession as observed in their sequence of development be noted, viz., corolla, calyx, androecium and gynoecium; although this order of parts does not correspond to Gœbel's generalizations on Compositæ.[5] There may be evidences showing a disturbance in the acropetal order of development of whorls, but of necessity the calyx is developed first, and its late appearance without doubt is due to the late liberation of its upper portion.

Simultaneously with the development of the ovule as far advanced as fig. 12, appear small, fleshy glands above the ovary at the base of the style these form a disk and are supposed to represent an inner row of imperfectly formed stamens.

[TO BE CONCLUDED]

[4]From all observations made I could not satisfactorily make out the descent of a pollen-tube.

[5]Gœbel's Outlines of Classification and Special Morphology, p. 422.

EXPLANATION OF PLATES XIX AND XX.

(All figures on Plate XIX are magnified 450 diameters; all on Plate XX 600 diameters).

Figs. 1, 2 and 3, receptacle of the flower axis, with individual florets appearing in Figs. 2 and 3*a*. Fig. 4, a single floret before the appearance of flower parts. Fig. 5*a*, the first floral whorl, the corolla. Fig 6, further development of corolla. Fig. 7, the corolla, the appearance of the andrœcium *a* and the calyx *b* Fig. 8, a later stage of fig. 7. Fig. 9*a*, the formation of the ovary; *b*, the bracteole. Fig 10, a further development of fig. 9, showing the flask-shaped ovary *a*. Fig. 11, the formation of the ovule with all other parts eliminated. Fig 12*a*, the nucellus of the ovule; *b*, appearance of the integument. Fig. 13, later development of fig. 12; *a*, the nucellus; *b*, the embryo-sac. Fig. 14, a further development of fig. 13. Fig 15, the mother-cell divided once. Fig. 16, the cells divided again Fig 17*a*, the true mother-cell of the embryo-sac, the upper three cells becoming disorganized. Fig. 18, disappearance of the upper cells, the mother cell occupying a central position, the nucellus breaking up and showing signs of disappearance. Fig. 19, a further development of Fig 18; the nucellus almost gone and the appearance of vacuoles. From fig. 20 to fig. 23, inclusive, are shown the division of the mother-cell and its further divisions, culminating in the formation of the egg-apparatus, the antipodal cells and the endosperm nucleus; the vacuoles and the expansion of the embryo-sac.

A study of some anatomical characters of North-American Gramineæ. IV.

THEO. HOLM.

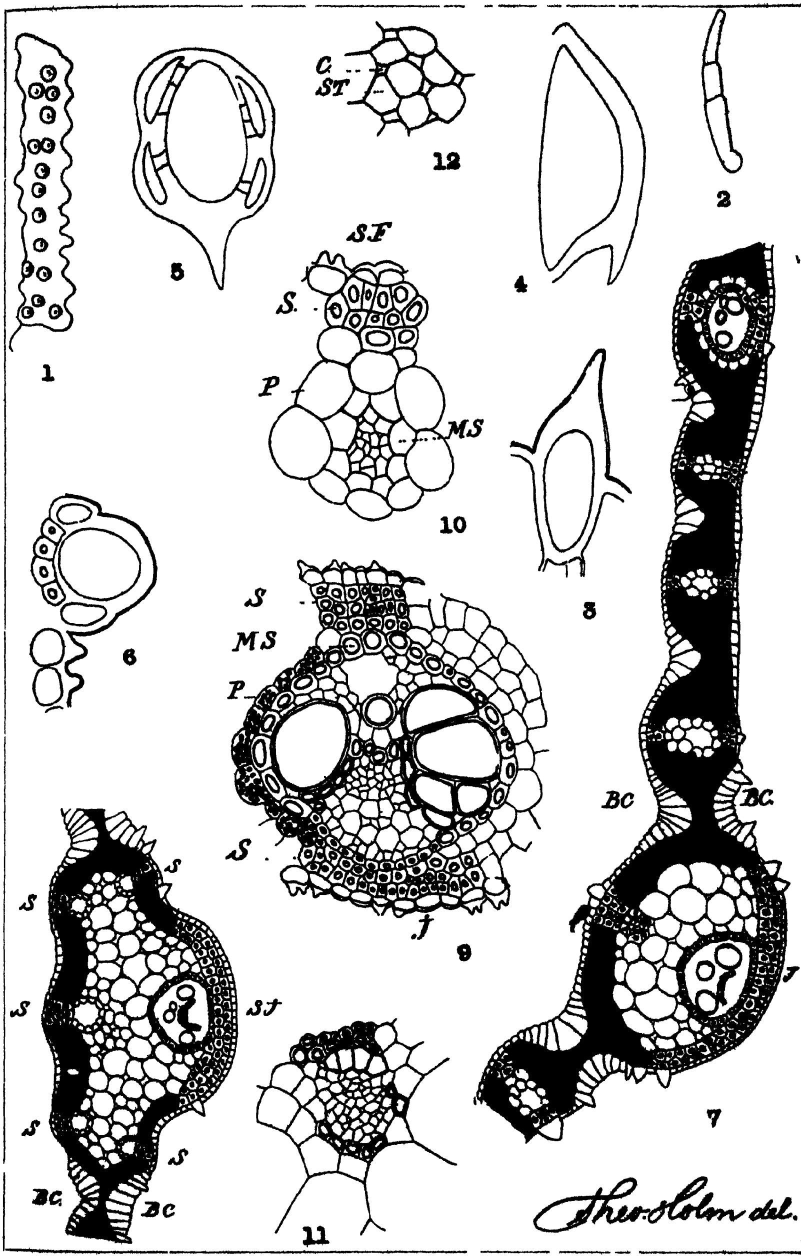
The genus Leersia.

(WITH PLATE XXI.)

In previously published papers[1] the anatomical characters of Uniola, Distichlis and Pleuropogon have been discussed, and it is the purpose of this, and a following paper, to show how the species of Leersia may be distinguished anatomically.

It would, of course, have been more proper to proceed from Uniola to the genera allied to it. This was done when the comparison was drawn between Uniola, Distichlis, and Pleuropogon; but the lack of sufficient material has necessitated a change in the order of treatment. Some groups, at least, of closely related genera may be considered at once, so as to give a broader view of their anatomical divergencies.

[1]Botanical Gazette, June, August and October, 1891.



HOLM on LEERSIA

Five species of Leersia are enumerated from this country, namely: *L. oryzoides* Swtz., *L. Virginica* Willd., *L. lenticularis* Michx., *L. monandra* Swtz. and *L. hexandra* Swtz.

LEERSIA ORYZOIDES Swtz. A series of anatomical sections has been figured on plate XX, and the rule has been followed strictly, as before, of taking the sections from the middle part of the blade of completely developed leaves. It must be noted, however, that such leaves only have been used for examination as are situated at the base of the culms or those belonging to the shoots of innovation.

The epidermis of the inferior face is very rough from several kinds of expansions, and represents two forms of cells: the proper epidermis cells and the bulliform cells. The first of these are rectangular, with thin undulate radial walls and strongly thickened exterior ones. Seen in transverse section (plate XX, fig. 9) they show a rather narrow lumen. These cells cover the entire face, excepting the two lines on the sides of the carene, where the bulliform cells are to be observed (figs. 7 and 8, at *BC.*). The different kinds of epidermal expansions, mentioned above, are straight or curved thorn-shaped expansions, warts and hairs. The first of these (fig. 3) are straight, pointed and very thick walled, and form several longitudinal lines outside of the mesophyll and among the bulliform cells. The curved ones, pointing downward, are also thick walled and very sharply pointed; their base is surrounded by four similarly thickened cells, distinctly porose (figs. 4, 5 and 6) these expansions are also numerous, arranged in lines outside the groups of stereome. The warts (fig. 1.) are roundish, obtuse and solid projections, of which about fifteen are present on each epidermis cell, excepting, where the curved, thorn shaped expansions are found. They are covered with a distinct cuticula like the other expansions. Hairs (fig. 2) are also present, consisting of three thin walled cells, the apical not pointed. They form a few longitudinal rows outside the mesophyll, but close to the stereome.

Stomata are present in largest number on this, the inferior, face of the blade; they form usually two rows on each side of the lines of stereome, and are situated close together in regular alternation with each other. The stomata themselves are in the same plane as the epidermis cells and are surrounded only by some of the wart-shaped expansions.

we compare the epidermis of the inferior with that of the superior face, there is but slight difference. The bulliform cells, occupying the largest part of the latter, form groups between all the mestome bundles; the stomata are less numerous, forming only one row on each side of the stereome.

The mestome bundles represent three degrees in this species, the difference depending upon the following characters: a thick-walled mestome sheath in connection with a layer of similarly thickened parenchyma, separating the leptome from the hadrome, both of which being well differentiated, are characteristic of those of the first degree (fig. 9). These, the largest bundles, including the midrib, are by no means so numerous as the small ones, representing the second degree. These last have a distinct, but thin walled mestome sheath inside the colorless parenchyma sheath, and have no layer of thick walled parenchyma between the leptome and the hadrome. The smallest bundles (fig. 10) contain only leptome but show the mestome sheath very distinctly. Besides these three forms of mestome-bundles, all of which lie in the same plane, there are from one (fig. 7) to three (fig. 8) very small ones which belong to the superior face of the carene. It is a marked characteristic of Leersia that the leaf possesses such small mestome bundles on the superior face. If there is only one, this is, as shown in figure 7, situated exactly above the large midrib; when three are present, the median one of these occupies that place, as shown in the figure 8. Morever in the same figure the carene has two small bundles on the inferior face, one on each side of the large, median one, which makes this leaf have in all six nerves in the carene, while the other section (fig. 7) shows only two.

It is difficult to say whether this difference does or does not depend upon the locality. We can only state, that the specimen from which figure 7 was drawn, was collected near Washington, D. C., in a wet place, while the other (fig. 8) was taken from a specimen collected in Texas. Duval-Jouve[1] has figured a leaf of the same species, and his drawing agrees perfectly with figure 8, but he does not state whether his specimen was from Europe or from America.

By examining these small bundles from the superior face

[1] Histotaxie des feuilles de Graminées. Annales d. Sc Nat. Botanique, Series VI, vol. I. (1875.) p. 294.

of the carene, it is seen (fig. 11) that some of them are not surrounded by any parenchyma or mestome sheath, and that the leptome is well developed, the hadrome, on the contrary, being less differentiated.

In regard to the parenchyma sheath, which surrounds all the other mestome bundles in the blade, it is seen, in transverse section, to be composed of roundish and thin-walled cells containing chlorophyll, except in the median bundle and in a few bundles next this. The sheath forms a closed ring in the mestome bundles of second and third degree, while in the largest ones it is interrupted above and below by the groups of stereome.

Mention has been made of the presence of a mestome-sheath in the bundles of the leaf of this species of Leersia. This fact has also been recorded by Schwendener [2] who enumerates the species of Gramineæ containing the sheath, as examined by him. It may here be mentioned that this author has observed the presence of this sheath in *Oryza sativa* and *Zizania aquatica* as well as in *Leersia oryzoides* of the group ORYZEAE. There is often, however, some difficulty in deciding whether such thick-walled sheaths are to be considered as mestome sheaths or not. In the case of *Uniola* (l. c.) it seems probable that there is no mestome sheath. But in regard to *Distichlis*, and the so-called *Uniola Palmeri*, which, as stated before (l. c.), ought not to be separated from *Distichlis*, these two plants seem to have true mestome sheaths. That this character was not attributed to them in the anatomical diagnosis lately given [2] was due to the fact that the small mestome bundles showed a distinct interruption of this sheath. Prof. Schwendener (*in litteris*)has kindly informed me that he considers it to be a true mestome sheath, even if it is broken in the smallest bundles, which, according to his very welcome criticism, is rather seldom. From this fact there seems to be a stronger reason for uniting *Uniola Palmeri* with the genus *Distichlis*, since both have typical mestome sheaths besides the other characters they have in common.

The stereome is quite strongly developed in Leersia oryzoides, and forms groups above and below all the mestome

[2] Die Mestomscheiden der Gramineenblaetter, p. 413.

[2] BOTANICAL GAZETTE, August and October 1891.

bundles, situated in the lateral parts of the blade; the bundles of the carene form an exception, as seen in the figures 7 and 8: the large median nerve having no stereome on its hadrome-side. The same peculiarity is also found in the small bundles next the median (fig. 8). The three small mestome bundles, situated on the superior face of the carene (fig. 8) have merely stereome on their hadrome side, while the leptome shows only a small layer of stereome cells or none at all. • One large isolated group of stereome is to be found in the outermost margin of the blade.

The mesophyll forms a dense tissue without any lacunes, and occupies a rather large part of the blade, as separate groups between the nerves. The mesophyll is in the carene restricted to the superior part of this, while a considerable layer of stereome covers the inferior face, the center part being occupied by a colorless parenchyma of considerable development.

U. S. Dep't of Agriculture, Washington, D. C.

EXPLANATION OF PLATE XXI.—Sections of the leaf of *Leersia oryzoides*.—Fig. 1. An epidermis cell of the inferior face of the blade, showing the roundish, wart-shaped expansions. × 400.—Fig. 2 Hair from the inferior face. × 400.—Fig. 3. Thorn-shaped expansion from the bulliform cells of the inferior face. • × 400.—Fig. 4.—A curved thorn-shaped expansion from the inferior face; longitudinal section. × 400.—Fig. 5 The same seen from the front. × 400.—Fig. 6.—The same, transverse section. × 400.—Fig 7. Transverse section of a part of the blade, including the carene *J*, the inferior face; *BC*, the bulliform cells. The specimen from which this section is taken was collected near Washington, D. C × 75.—Fig 8. Similar section, but from a specimen collected in Texas. × 75.—Fig 9. Transverse section of one of the largest mestome bundles. There is, besides, a chlorophyll bearing parenchyma sheath *(P)*; a thick-walled mestome sheath *(MS.)*, which surrounds the leptome and the hadrome. *S*, the stereome. *J*, the inferior face of the blade. × 320.—Fig. 10. Transverse section of a small mestome bundle from the lateral part of the blade. Letters as above. The parenchyma sheath is colorless and thin-walled, like the mestome sheath. *SF*, the superior face of the blade. × 400.—Fig. 11. Transverse action of a small mestome bundle situated on the superior face of the carene. × 320.—Fig. 12. A part of the leptome of the midrib, showing the sieve tubes *(ST.)* and the companion cells *(C)* in transverse section. × 400.

Popular American plant names.

FANNIE D. BERGEN.

[At the request of the author and from plates kindly furnished by the editor of the *Journal of American Folk-lore*, Mr W W. Newell, the following is reprinted from that journal, both because of its intrinsic interest to botanists and for the sake of assisting the author in getting a more complete list of well authenticated local names In this endeavor our readers are urged to coöperate, by sending such names to Mrs. Fannie D Bergen, 17 Arlington st., North Cambridge, Mass.—Eds.]

The following list of names of common wild and cultivated plants has been prepared in the hope that it may suggest to folk-lorists who have some acquaintance with botany the importance of recording and communicating such names as may come to their knowledge. This work has been very thoroughly done in Great Britain; it is time that something like it should be attempted for our own flora.

In some cases, when I have taken the name from some one's description, there has been uncertainty as to the species, although there was no doubt about the genus; so that, in a few instances, I have only been able to give the latter.

It is interesting to notice the part certain nouns, used as adjectives or in composition, play in popular plant-names. *Horse*, *cow*, and *bull* have been generally used to designate unusually large and luxuriantly growing species, as the bull-thistle or horse-mint, or they are applied to coarse, common plants, as the horse-radish, the cow-lily. *Dog*, *pig*, or *sow* generally seems to carry the idea of commonness, as dog-fennel, pig-weed, sow-thistle. *Goose* and *toad* are less frequently used in much the same sense, *e. g.* goose-grass, toad-flax. The word *Indian* we find in constant use to distinguish wild species from those tame or more familiar ones which they somewhat closely resemble. *Mollugo verticillata* is thus called Indian chickweed, to distinguish it from the omnipresent common chickweed, *Stellaria media*, which is naturalized from Europe. Not infrequently the "Indian" namesake of some well-known plant may be used as at least a nominal substitute for the latter, *e. g.* Indian tobacco, *Antennaria plantaginifolia*, is chewed by children. Now and then, hints and traditions of the use of certain plants in the rude medical practice of our Indians may have resulted in fastening the name Indian to that of these plants, and it is evident enough that the Indian rice, *Zizania aquatica*, owes the first part of its popular name to the great importance which some tribes attached to it as an article of food.

The word *snake* plays an interesting part, too, in our popular botanical vocabulary. In general, "snake" indicates a plant supposed to be poisonous, or one which exerts a malign influence, yet sometimes it is applied to a plant that is thought to act as an antidote to the venom of snakes. A botanist from St Stephen, N. B., writes: "Almost any unfamiliar berry is or may be snake-berry, and all snake-berries are poisonous; so a boy dares not eat a berry till some one tells him that it is good. Hence, though no two agree as touching the identity of the snake-berry, the name is very common." I find, too, curiously enough, that "snake" is sometimes used by a people no less widely removed from us than the Japanese to designate fruit unfit to be eaten by man. For instance, a beautiful large red fruit much resembling the strawberry, but whose flavor is perfectly insipid, is popularly called snake-berry, signifying that it is only fit food for snakes. Our popular name of Devil's apron for the familiar kelp, *Laminaria longicruris*, doubtless arises from the giant size of some of these plants, and I am told that in Japan this prefix sometimes designates an unusually large species. For instance, a monstrous thistle is called devil-thistle. Also a large variety of the particular rhomboidal-shaped Chinese nuts called hishi are popularly known in Japan as devil-hishi. However, with the Japanese as with us, *devil* may mean "armed," or uncanny in appearance, as the "devil-lotus," one with very prickly leaves. Our well-known prickly pear, *Opuntia Rafinesqii* or *O. vulgaris*, when cultivated in northern Ohio, is somewhat generally known as devil's tongue, which must seem a most fitting name to any one who has imprudently filled the tips of his fingers with the insinuating barbed bristles.

As a rule, I have here entered only such popular names of wild plants as are not recorded in the new edition of Gray's Manual. Wood's Botany contains some of those that I have collected from various parts of the country, but such as I have here retained as are found in either of these floras are given for the sake of designating special localities for such names, or because of some note that seemed worth appending.

In those instances in which I have given as locality only the name of the State, it is either because the name is known to be in use in various parts of the State, or because my informant could not give the county or town. Some names given are such as were certainly current a good many years ago in the localities cited, but have not been verified as still existent there. It would often have been very difficult to make inquiries about the present currency of these names; hence they have been allowed to stand as probably still in use.

RANUNCULACEÆ.

Clematis Virginiana, traveller's joy; wild hops. N. H.
devil's darning needle. So. Vt.
Anemone nemorosa, wild cucumber. N. H.
Mayflower. Boston.
Hepatica triloba, mouse-ears. Mason, N. H.
Mayflower. Hemmingford, P. Q.
Anemonella thalictroides, wind-flower. Mansfield, O.
Thalictrum polygamum, rattlesnake-bite. N H.
muskrat-weed; musquash weed. South-bridge, Mass.
Thalictrum dioicum, shining grass.[1] Weathersfield, Vt.
Ranunculus (double garden buttercups), golden daisies. Richland Co., O.
Ranunculus aquatilis, var. *trichophyllus*, moss (gives name to "Moss Creek," Carroll Co., Mo.).
Caltha palustris, May-blobs. Salem, Mass.
coltsfoot. Stratham, N. H.
Coptis trifolia, yellow-root. N. H.
Nigella Damascena, love-in-a-mist; lady-in-the-green. N. E. and Westward.
lady-in-a-chaise. N. H.
devil-in-a-bush. Northern Ohio.
St. Catherine's flower. (Locality ?)
ragged lady. Wisconsin.
Aquilegia Canadensis, honeysuckle. N. E.; Peoria, Ill.
rock-lily. Mason, N. H.
cluckies. Annapolis Co., N. S.
meeting-houses. New England.
Aconitum Napellus, Venus' chariot.[2] Brookline, Mass.
Actæ spicata, var. *rubra*, snake-berry. Belleisle, N. B.

NYMPHÆACEÆ.

Nelumbium luteum, chinquapins. Carroll Co., Mo.
Nuphar advena, cow-lily. Washington Co., Me.
dog-lily. New England.
beaver-lily. Me.
bull-head lily. N. H.
ducks.[3] Chestertown, Md.

[1] See, also, *Impatiens*. The name is given because of the silvery appearance of the leaves when immersed in water.
[2] The swans are hidden in the hood.
[3] Quy. *docks*, as in spatter-dock ?

SARRACENIACEÆ.

Sarracenia purpurea, Adam's cup. Dudley, Mass.
foxglove. N. H
Indian pitcher. N. B.

PAPAVERACEÆ.

Eschscholtzia, California poppy. General.
cups-of-flame. New England.
Papaver (a small species), coquettes.[1] Mansfield, O.
Argemone Mexicana, bird-in-the-bush. Arlington, Mass.
flowering thistle. Mansfield, O.
Sanguinaria Canadensis, snake-bite. N. H.

FUMARIACEÆ.

Adlumia cirrhosa, Alleghany vine. N. Ohio.
mountain fringe. So. Vt.; E Mass.
fairy creeper. Fredericton, N. B.
Dicentra spectabilis, diethra. Mass.

CRUCIFERÆ.

Lepidium Virginicum, birds' pepper. Nebraska.
Capsella bursa-pastoris, pepper-plant. Allston, Mass.

VIOLACEÆ.

Viola palmata, var. *cucullata*, hood-leaf violet. Franklin, Mass.
Viola (sp unknown), rooster hoods. Buncombe Co., N. C.
Viola sagittata, spade-leaf violet. Franklin, Mass.
Viola Canadensis, June flower. Woodstock, N. B.; Houlton, Me.
Viola tricolor, lady's delight. Mass.
Cupid's delight. Salem, Mass.
Johnny-jump-up.[2] O. and Ill.
Viola pedata, horseshoe violet. Concord, Mass.
Crowfoot violet. New England.
horse violet. New England.

DROSERACEÆ.

Drosera rotundifolia, eye-bright. N. H.

CARYOPHYLLACEÆ.

Dianthus barbatus, bunch pink. Vt.; So. Ohio.
Saponaria officinalis, old maid's pink; London pride. Salem, Mass.
woods phlox. N. J.

[1] French *coquelicot*.

[2] In Mansfield, Ohio, this name is commonly abbreviated into Johnnies, and this nickname is often applied by children to the common wild blue violet.

Silene cucubalus, snappers. Salem, Mass.
Silene Armeria, wax-plant. Mansfield, O.
sweet Susan. N. H.
none-so-pretty. Hatfield, Mass.
pretty Nancy. Franklin Center, P. Q.
Silene noctiflora, gentlemen's hats. Gilsum, N. H.
Lychnis Githago, old maid's pink. N. H.
mullein pink. Annapolis Valley, N. S.
Lychnis chalcedonica, sweetwilliam. Weathersfield, Vt.; So. Ohio.
fire-balls. Mansfield, O.
scarlet lightning.[1] Hemmingford, P. Q.

PORTULACACEÆ.

Portulaca oleracea, pusley. U. S.
Portulaca grandiflora, Mexican rose. Chestertown, Md.
rose-moss. So. Nebraska.
French pusley. So. Vt.
Claytonia Virginica, good-morning-spring. (Locality ?)
wild potatoes. Union Co., Pa.
Mayflower. Hemmingford, P. Q.

MALVACEÆ.

Abutilon Avicennæ, butter-weed. Peoria, Ill.
sheep-weed; Mormon-weed; velvet-weed. Quincy, Ill.
button-weed. Chestertown, Md.
Abutilon striatum, flowering maple. Mansfield, O.
Malva rotundifolia, cheeses, or cheese-plant. U. S.
Malva moschata, musk-plant or musk. Mansfield, O.
Hibiscus trionum, black-eyed Susan. N. H.; N. B.
devil's-head-in-a-bush. N. H.

GERANIACEÆ.

Geranium maculatum, chocolate-flower. Stratham, N. H.
Pelargonium (common pink and white species or var.), apple geranium. Mansfield, O., and parts of Mass.
Oxalis stricta, ladies' sorrel. Allston, Mass.; Stratham, N. H.
Impatiens fulva, snap-dragon. N. H.
snap-weed. N. B.
kicking colt. E. Mass.
shining grass.[2] Weathersfield, Vt.

[1] Probably a corruption for *Lychnis*.
[2] See note on *Thalictrum dioicum*.

balsam-weed ; slipper-weed ; lady's ear-drop. Mansfield, O.
lady's slipper. Plattsburg, N. Y. ; Mansfield, O.
lady's pocket. Mansfield, O.
Impatiens balsamina, lady's slipper. Mansfield, O.

ILICINEÆ.

Nemopanthes fascicularis, brick-timber ; cat-berry.[1] Fortune Bay, Newfoundland.

CELASTRACEÆ.

Celastrus scandens, Roxbury wax-work. E. Mass.
Jacob's ladder. Stratham, N. H.
Euonymus atropurpureus, Indian arrow. Salem, Ind.
Pachystima Canbyi, rat-stripper. N. J.

VITACEÆ.

Vitis cordifolia, chicken grapes. Chestertown, Md.

ANACARDIACEÆ.

Rhus glabra, shoe-make. Ohio and Ill.
Rhus toxicodendron, black mercury. Harmony, Me.
mercury or markry. N H.
mark-weed. Kennebec Co., Me.

POLYGALACEÆ.

Polygala paucifolia, babies' feet. N. H.
babies' toes. Hubbardston, Mass.

LEGUMINOSÆ.

Crotalaria (*ovalis ?*), rattlesnake-weed. Mansfield, O.
Genista tinctoria, wood-wax. Essex Co., Mass.[2]
Lupinus perennis, wild pea. Worcester Co., Mass.
Lupinus villosus, monkey faces ; sun-dial.[3] N. Ohio.
Trifolium pratense, "real sweet clover." Mass. and parts of Me.
Amorpha canescens, shoestrings. Ill.
Apios tuberosa, traveller's delight. New Albany, Miss.
wild bean. N. B.
Phaseolus multiflorus, flower bean. Mansfield, O.

[1] This, like most of the other names quoted from Newfoundland, is taken from Rev. A. C. Waghorne's *Wild Berries and other Edible Fruits of Newfoundland and Labrador*.

[2] In this its principal American locality, the plant is never called wood-waxen, or any other name than that above given.

[3] So called from the monkey-like profile of the seed.

Arachis hypogæa, ground-nut. Chestertown, Md.
goobers. Southern.
pinders. Miss.
ground-peas. Ky.
Schrankia uncinata, sensitive rose. West and South.
Schrankia sp., shame-vine. N. Miss.

ROSACEÆ.

Prunus serotina, rum-cherry.[1] N. E.
Prunus Americana, wild goose plum. Chestertown, Md.
Prunus hortulana, wild goose plum. Markets of Boston and elsewhere.
Prunus maritima (?), mountain cherry. Chestertown, Md.
Spiræa sp., spice hard-hack. Bonny River, N. B.
Rubus odoratus, mulberry ; Scotch caps. Hemmingford, P. Q.
Rubus chamæmorus, baked apples. New Brunswick and Grand Manan Id.
bake-apple-berry. Grand Manan.
Rubus triflorus, mulberry. Washington Co., Me. ; N. B.
dewberry. N. B.
plumbog. Newfoundland.
swamp-berry. Newfoundland.
Rosa cinnamomea, kitchen rose. Boston, Mass.
Pyrus arbutifolia, dog-berry. N. E.
choke-pear. Washington Co., Me.
Pyrus Americana, witch-wood.[2] N. H.
round-tree (for rowan-tree). N. B.
dog-berry. Newfoundland.
missey moosey. N. H.
Cydonia Japonica, scarlet thorn. Chestertown, Md.
flowering quince. O., and somewhat general.
Cratægus, thorn-apple. Mansfield, O.
Amelanchier Canadensis, June berry. Various parts of N. E. and Central States.
sugar plum ; shad-blow. N. H.
sugar pear. Washington Co , Me.
juice-pear or juicy pear. Provincetown, Mass.
May-pear.[3] N. B.

[1] From its use in flavoring "cherry rum." In the W. and S. whiskey is used with these cherries to make "cherry bounce."
[2] If carried, supposed to keep off witches.
[3] From time of blooming.

SAXIFRAGACEÆ.

Saxifraga Virginiensis, Mayflower. Allston, Mass.
Ribes prostratum, skunk currant.[1] Washington Co., Me.
Ribes aureum, flowering currant. General.
clove currant. Cambridge, Mass.

CRASSULACEÆ.

Sedum acre, love entangled. N. Ohio.
Sedum (*pulchellum?*), flowering moss. Mansfield, O.
Sedum Telephium, witches' money-bags. W. Mass.
evergreen. Chestertown, Md.
everlasting. Hemmingford, P. Q.
Aaron's rod. New Hampshire.
frog's mouth; frog's bladder. N. Y.
pudding-bag plant. Mass.
leeks. Stowe, Vt.
frog-plant.[2] N. H.
frogs' throats. Bedford, Mass.
Sempervivum tectorum, hen and chickens. N. Ohio.
Bryophyllum calycinum, life-plant. Cambridge, Mass.

ONAGRACEÆ.

Œnothera fruticosa, scabbish. N. H.

CUCURBITACEÆ.

Lagenaria sp., mock orange. N. Ohio; Central Ill.
Echinocystis lobata, wild cucumber. N. B., and U. S. generally.

BEGONIACEÆ.

Begonia metallica, elephant's ears. Bedford, Mass.
Begonia maculata, trout begonia. Bedford, Mass.
fish begonia. Cambridge, Mass.
Begonia Warscewiczii, pond-lily begonia. Cambridge, Mass.
Begonia sp. (similar to *B. maculata*, but not spotted), coral begonia. Bedford, Mass.
Begonia sp., beefsteak geranium. Mansfield, O.
strawberry geranium. Mansfield, O.

CACTACEÆ.

Opuntia Rafinesqii, or *O. vulgaris.* } devil's tongue. N. Ohio.

[1] From the offensive musky smell of the fruit.
[2] Because of a children's custom of blowing up a leaf so as to make the epidermis puff up like a frog.

FICOIDEÆ.

Mesembryanthemum sp., dew plant. N. Ohio.
rat-tail pink. Dorchester, Mass.

UMBELLIFERÆ.

Daucus carota, parsnip. Harmony, Me.
Erigenia bulbosa, turkey-pea. (Locality ?)

ARALIACEÆ.

Aralia racemosa, Indian root ; life of man ; petty morrell. N. H.
spignut. Vt.

CORNACEÆ.

Cornus Canadensis, bunch plums ; pudding-berry.[1] N. H.
pigeon-berry. N. B.
cracker-berry.[1] Newfoundland.
Cornus stolonifera, red-brush. Central States.
Nyssa sylvatica, hornbeam. N. H.

CAPRIFOLIACEÆ.

Viburnum lantanoides, moosewood. Mass.
Viburnum opulus, high-bush cranberry. Washington Co., Me., and N. B.
witch-hobble. N. H.
Viburnum nudum, withe-wood. N. H.
bilberry. Annapolis Royal, N. S.
Linnæa borealis, two-eyed berries. St. Stephen, N. B.
Symphoricarpus racemosus, snow-drop. Mansfield, O.

RUBIACEÆ.

Houstonia cærulea, blue-eyed babies. Springfield, Mass.
Quaker ladies. Concord, Mass. ; Boston.
innocence. Boston, Mass.
eyebright. Isles of Shoals.
angel-eyes. (Locality ?)
bright-eye. Baltimore, Md.
forget-me-not. Kentucky.
star of Bethlehem. Miss.
Quaker beauty. (Locality ?)
Nuns. (Locality ?)
Cephalanthus occidentalis, pin-ball. N. H.

[1] Probably from its insipid character.

Mitchella repens, squaw-vine. Parts of N. E.
snake-berry. N. Y.
cow-berry. Ulster Co., N. Y.
boxberry. Bedford, Mass.
two-eye-berry. Wakefield, Mass.

COMPOSITÆ.

Eupatorium purpureum, motherwort. Brookfield, Mass.
Queen-of-the-meadow. Worcester Co., Mass.
marsh milkweed. Mass.
Solidago (any sp.), yellow-tops. N. B.
Callistephus Chinensis, fall roses. Mansfield, Ohio.
Aster (any sp.), frost-flowers. N. B.
Erigeron Canadense, cow-tail. Normal, Ill.
Antennaria plantaginifolia, Indian tobacco. N. E.; Neb.
woman's tobacco. Boston, Mass.
ladies chewing tobacco. Wisconsin.
pussy's toes. Worcester, Mass.
dog toes. N. H.
Anaphalis margaritacea (?), life-of-man. N. H.
Gnaphalium polycephalum, life everlasting. N. E.; No. Ohio.
old field balsam. N. E.
life-of-man. Stratham, N. H.
fuzzy-guzzy. Mansfield, O.
feather-weed.[1] No. New York.
Ambrosia artemisiæfolia, tassel-weed. Hingham, Mass.
Zinnia elegans, youth-and-old-age. Mansfield, O.
Rudbeckia hirta, yellow daisies. Mass., N. B., and general.
golden Jerusalem. N. H. (local).
black-eyed Susans. N. Vt.; Cape Cod.
nigger-heads. (Name apparently brought from So. U. S.) N. B.
nigger daisy. E. Mass.
Coreopsis tinctoria, Rocky Mt. flower. Mansfield, O.
Bidens (all species), Spanish needles. Ill., and Central States generally.
Anthemis cotula, dog-fennel. General.
pigsty daisy. Ipswich, Mass.
Chrysanthemum leucanthemum, pismire. East Weymouth, Mass.
bullseye. N. B.

[1] Name given because the heads were used by poor people to fill beds, as a substitute for feathers.

Artemisia abrotanum, boy's love;[1] lad's love.[1] Various parts of New England.
old man.[1] Ohio; Ill.
Leamington. Ipswich, Mass.
Artemisia sp., old woman.[1] N. Ohio.
Xeranthemum, *Helichrysum*, } paper-flowers. N. Ohio.
Cnicus pumilus, bull-thistle. New England.
Cnicus (any species), stickers. St. John, N. B.
Cichorium Intybus, blue dandelion. N. H.
blue sailors. Brooklyn, N. Y.
Leontodon autumnalis, arnica. E. Mass.
Lactuca (any species), milkweed. N. B.

LOBELIACEÆ.

Lobelia cardinalis, slink-weed. Princeton, Mass.

ERICACEÆ.

Gaylussacia (all species), black hurts.[2] Newfoundland.
Vaccinium (many species), whortleberry; bilberry. Newfoundland.
any low blueberry; ground-hurts. Newfoundland.
Vaccinium (any species under sub-genus Cyanococcus), bluets. N. B., among French Canadians.
Vaccinium Oxycoccus, marsh cranberry. N. B.
marshberry. Newfoundland.
Vaccinium macrocarpon, marsh cranberry. N. B.
bearberry; bankberry. Fortune Bay, Newfoundland.
Vaccinium Vitis-Idæa, rock cranberry. N. B.
Chiogenes serpyllifolia, ivory plums. Washington Co., Me.
capillaire; maiden-hair;[3] teaberry. New Brunswick.
Arctostaphylos uva-ursi, crowberry. Barnstable, Mass.; Kinnikinnik, Newfoundland.
rockberry. Fortune Bay, Newfoundland.
Epigæa repens, shad-flower. Conn.

[1] Names apparently given from supposed aphrodisiac qualities, or because used in love divinations.

[2] "Hurts" is an abbreviation for "whortleberry."

[3] This name, attached to a description of the plant, was the occasion of an indignant protest by a botanist in England at the idea of the maidenhair (fern) being supposed to flower and fruit in New Brunswick!

Gaultheria procumbens, young plantlets; drunkards.[1] Barnstable, Mass.
youngsters.[2] Me.; Mass.
jinks or chinks. N. H.; Mass.
young chinks. Mason, N. H.
pippins.[3] Stratham, N. H.; Central Mass.
young ivories; ivory plums. N. H.
ivory leaves; ivory plums. Ipswich, Mass.; Me.
mountain tea. Eastern Ohio.
ivy-berry. N. B.
deer-berry. (Locality?)
one-berry. (Locality?)
chicken-berry. Penn.

Kalmia latifolia, spoon-hunt. Mason, N. H.

Kalmia angustifolia, sheep-poison. N. E.
spoon-wood ivy. Conn.

Rhododendron viscosum, swamp-pink. Allston, Mass.

Rhododendron nudiflorum, election pink. Hillsborough, N. H.
river pink. Cavendish, Vt.
swamp pink. Parts of N. E.
swamp apple. E. Mass.
honeysuckle. Md.

Rhododendron Rhodora, lambkill. N. B.

Chimaphila umbellata, noble pine; bittersweet. N. H.
love-in-winter. Maine.

Chimaphila maculata, ratsbane; wild arsenic. Blue Ridge, Va.

Monotropa uniflora, convulsion-root. N. H.
ghost-flower. N. B.

DIAPENSIACEÆ.

Pyxidanthera barbulata, pyxie moss. N. J.

PRIMULACEÆ.

Primula grandiflora, polyanthus. So. Vt.; Cambridge, Mass.; Mansfield, O.
cups-and-saucers. Mansfield, O.

Trientalis Americana, Star-of-Bethlehem. N. H.
star anemone. Cambridge.

APOCYNACEÆ.

Vinca minor, myrtle. General.

[1] Believed by children to intoxicate.
[2] Young berries and shoots.
[3] Young leaves.

ASCLEPIADACEÆ.

Asclepias tuberosa, white root; yellow milk-weed. W. Mass.

GENTIANACEÆ.

Gentiana Andrewsii, blind gentian. Haverhill, Mass.

POLEMONIACEÆ.

Phlox pilosa, sweetwilliam. Fort Worth, Tex.
Phlox subulata, flowering moss. No. Ohio.
Phlox, cult. sp., Lady Washington. Mansfield, O.
Polemonium reptans, bluebell. Mansfield, O.

BORRAGINACEÆ.

Cynoglossum officinale, sheep-lice. No. Ohio.
Echinospermum Virginicum, soldiers. E. Mass.

CONVOLVULACEÆ.

Convolvulus sepium, creepers. Mansfield, O.
Rutland beauty. Temple, N. H.
Cuscuta sp., love-vine. Fort Worth, Tex.

SOLANACEÆ.

Datura Stramonium, *Datura Tatula*, } Jimson or Jimpson[1] weed. W. and S.
Lycium vulgare, privy; Jackson vine; jasmine. Mansfield, O.
jessamine. Stratham, N. H.

SCROPHULARIACEÆ.

Linaria vulgaris, Jacob's ladder. Parts of N. E.
bread-and-butter. Ipswich, Mass.
dead men's bones. Troy, N. Y.
Antirrhinum majus, lion-mouth. Mansfield, O.
Chelone glabra, bammany (for balmony ?). Belleisle, N. B.
Gerardia quercifolia (?), corn-flower. Hillsborough Co., N. H.
pedicularia (?)
Castilleia coccinea, paint-brush. Peoria, Ill.; N. H.; Hemmingford, P. Q.
Indian paint-brush. Mass.
Red Indians. Mass.
Wickakee.[2] Mass.
election posies. Dudley, Mass.
prairie fire. Wisconsin.

[1] Evidently a corruption of Jamestown, where the plant is most abundant. This corrupted form of the name is universal.
[2] An Indian name.

BIGNONIACEÆ.

Tecoma radicans, foxglove. Chestertown, Md.

VERBENACEÆ.

Verbena stricta, fever-weed.[1] Peoria, Ill.

LABIATÆ.

Nepeta Glechoma, Robin runaway. N. H.
creeping Charlie; Jack-over-the-ground; Gill-over-the-ground. E. Mass.
wild snake-root. Cambridge, Mass.
crow-victuals.[2] Chestertown, Md.
Brunella vulgaris, carpenter-weed. N. H.

NYCTAGINACEÆ.

Mirabilis Jalapa, pretty-by-night. Fort Worth, Tex.

AMARANTACEÆ.

Gomphrena globosa, French clover. No. Ohio.
globes. So. Vt.

CHENOPODIACEÆ.

Salicornia herbacea, chicken's toes. Kittery, Me.

POLYGANACEÆ.

Rheum Rhaponticum, pie-plant. General in Middle States and westward.
Rumex acetosella, horse-sorrel. Mansfield, O.
toad's sorrel. Stratham, N. H.
cow-sorrel.[3] Miramichi, N. B.
gentlemen's sorrel. Cambridge, Mass.
sheep-sorrel. Wisconsin; So. Vt.
Polygonum aviculare, wire-grass. No. Ohio.
door-grass. So. Ind.
Polygonum acre, turkey-troop. Long Island, N. Y.

EUPHORBIACEÆ.

Euphorbia maculata, milkweed. No. Ohio.
Euphorbia marginata, Snow-on-the-mountains. N. H.; Neb.
Euphorbia Cyparissias, tree-moss. Mansfield, O.
cypress. Rye Beach, N. H.
butternut. Harmony, Me.
Irish moss. N. B.

[1] Thought to be a specific for fever and ague.
[2] Name used by the negroes. [3] Usually pronounced "cow-serls."

Euphorbia Lathyris, mole-tree.[1] No. Ohio.

JUGLANDACEÆ.

Carya tomentosa, bull-nut. Peoria, Ill.

MYRICACEÆ.

Myrica cerifera, candle-berry. Worcester Co., Mass.

CONIFERÆ.

Larix Americana, Juniper-tree. Newfoundland.
Juniperus communis, hackmatack. Ipswich, Mass.
fairy circle. E. Mass.
Juniperus sabina, var. *procumbens*, savin.[2] Newfoundland.

ORCHIDACEÆ.

Arethusa bulbosa, dragon's mouth. Dudley, Mass.
Habenaria orbiculata, Solomon's seal. Barre, Vt.
Habenaria fimbriata, meadow pink. Mass.
Cypripedium acaule, nerve-root. N. B.
whip-poor-will. Boston, Mass.
Cypripedium spectabile, nerve-root. N. B.
whip-poor-will shoes. Conn.

SCITAMINEÆ.

Canna Indica, adder's spear. Waltham, Mass.

AMARYLLIDACEÆ.

Narcissus Pseudo-Narcissus, Easter-flower. Mansfield, O.
daffy. Stratham, N. H.
Narcissus poeticus, single daffy. Stratham, N. H.

IRIDACEÆ.

Iris pumila, crocus. Stratham, N. H.
Iris versicolor, poison flag.
flag-lily.
water-flag. [3]
liver-lily.
snake-lily.
Belamcanda Chinensis, dwarf tiger-lily. Mansfield, O.

[1] Supposed to keep moles out of gardens.
[2] The berries used in domestic medicine, and called face-and-eye berries.
[3] These names are taken from Hobbs' *Botanical Handbook*.

LILIACEÆ.

Smilax rotundifolia, biscuit-leaves; bread-and-butter.[1] Allston, Mass.
wait-a-bit.[2] E. Mass.
nigger-head. Miramichi, N. B.
Muscari botryoides, baby's breath. E. Mass.
bluebell. Chestertown, Md.
bluebottle. Mansfield, O.
Yucca filamentosa, thread-and-needle. Mass.; N. Y.
Eve's darning needle. Fort Worth, Texas.
Maianthemum Canadense, cowslip. Dennysville, Me.
lily-of-the-valley; two-leaved Solomon's seal. N. H.
Clintonia borealis, cow-tongue. Aroostook Co., Me.; N. B.
heal-all. N. B.
Oakesia sessilifolia, wild oats. N. H.
Lilium superbum, nodding lilies; Turk's head. Mass.
Erythronium Americanum, yellow bells. Boston (?).
Trillium erectum, dish-cloth or stinking dish-cloth. Franklin Center, P. Q.
bumble-bee root. New England.
squaw-root. N. H.
Benjamins. So. Vt.
stinking Benjamin. N. B. (Any Trillium in N. B. is called Benjamin.)
Trillium grandiflorum, white lilies. No. Ohio; Chestertown, Md.
Trinity lily. Wisconsin.
Trillium erythrocarpum, Benjamins. New England.

COMMELINACEÆ.

Tradescantia crassifolia, wandering Jew. General.
inch-plant. Salem, Mass.
joint-plant. Cambridge, Mass.
Jacob's ladder. Hemmingford, P. Q.

ARACEÆ.

Arisæma triphyllum, bog onion. Worcester Co., Mass.
wild turnip. Stowe, Vt.
Jack-in-the-pulpit. General.
Symplocarpus fœtidus, Polk-weed (poke weed?). Brookline, Mass.

[1] The young leaves eaten by children.
[2] On account of the difficulty of tearing loose clothing caught by its stout prickles.

GRAMINEÆ.

Cenchrus tribuloides, sand-burr. Ill. and westward.
Zea mays, a species of pop-corn, with variegated ears; guinea-corn.[1] Mansfield, O.
yellow kernels, striped with red; calico corn. Ill.
long, indented kernels; dent corn. General.
horse-tooth corn. Central Ill.

FILICES.

Pteris aquilina, hog-brake. N. H.
Osmunda regalis, buck-horn. Worcester Co., Mass.
Osmunda cinnamomea, fiddle-heads.[2] Central Me.
Osmunda sp., fiddle-heads. Petit Codiac, N. B.

LYCOPODIACEÆ.

Lycopodium clavatum, coral evergreen. Stratham, N. H.
creeping Jenny. N. B.
Lycopodium dendroideum, bunch evergreen. Stratham, N. H.
crowfoot. Chestertown, Md.
Lycopodium complanatum, creeping Jenny. Bedford, Mass.
liberty. Chestertown, Md.
ground-cedar. N. B.

MUSCINEÆ.

Polytrichum commune, bears' bread. Dennysville, Me.
rum-suckers.[3] Stratham, N. H.
Bryum sp., robin-wheat. Mansfield, O.

FUNGI.

Hymenomycetes (any umbrella-shaped species), devil's umbrellas. Baltimore, Md.
Phallus sp., death-baby.[4] Salem, Mass.
Ustilago Maydis (the smut of Indian corn), Devil's snuff-box. Chestertown, Md.
Cladonia bellidiflora (a common lichen), red-cup moss. General in N. E.

[1] Because speckled like a guinea-fowl.

[2] Under this name the unrolling fronds considerably sought and eaten as "greens."

[3] So called from the supposed spirituous taste of the pasty mass of unripe spores.

[4] Name given from the fancy that they foretell death in the family near whose house they spring up. I have known of intelligent people rushing out in terror and beating down a colony of these as soon as they appeared in the yard.

Usnea sp. (a tufted hair-like lichen), whisker-moss. Mansfield, O.

ALGÆ.

Laminaria (*saccharina?*). Venus's apron-strings. Brookline, Mass.
Laminaria longicruris, Devil's apron-strings; Deb's apron-strings. Portland, Me.
Devil's apron. N. E. coast.
Spirogyra and allied confervaceae, frog-spit. U. S.
frog-spawn. Parts of N. B

BRIEFER ARTICLES.

The systematic position of Entosthodon Bolanderi.—In February, 1889, Dr. Edward Palmer, collecting in Lower California for the Department of Agriculture, found this species in thevicinity of Port San Quentin, about a hundred miles south of San Diego. This greatly extends southward the range of this species. It looks much like *Funaria Californica* Sulliv. & Lesq., in outward appearance, but differs from it in the more acuminate leaves, in the capsule more long-necked and constricted under the orifice when dry and in the mamillate lid. Closer examination of the plants, which are in excellent condition, shows furthermore only a rudimentary peristome; the costa ceases above the middle of the leaf; the cells near the apex of the leaf are more elongated.

A search in the material of the closely allied genus Entosthodon led to the discovery of this identical species under the name of *Entosthodon Bolanderi* Lesq. The one specimen in the National Herbarium comes from the herbarium of Lesquereux himself, and is labelled: "*Entosthodon Bolanderi* Lesq. Ad terram argillosam, prope San Francisco, Californiæ. No. 236. Leg. Bolander."

A comparison of Palmer's plants with this specimen, and with the figures in Sulliv. Icon. Suppl. t. 17, shows them to *agree* in all respects, except that the figure and description make no reference to the *inner rudimentary* peristome, distinctly present in the specimens of Lesquereux collected by Bolander, as well as in Palmer's specimens. This peristome is as pronounced as in Funaria microstoma. In specimens of Funaria Californica in the National Herbarium, it is not nearly so well developed as figured in Sulliv. Icon. Suppl. t. 18, but is almost as

rudimentary as in the plants collected by Palmer. So that practically there remain only two prominent points of distinction between Funaria Californica and Entosthodon Bolanderi: the *lid*, being convex in the former and mamillate in the latter; and the *costa*, passing to the apex in the former, and only to about the middle in the latter.

The color of the peristome, described as "pale, whitish, granulose," is found in both the specimens of Bolander and those recently collected by Palmer, to be in fact *red, granulose, longitudinally striate*, and distinctly articulate. This discrepancy is quite likely due to the difference in maturity of the material examined. The calyptra, referred to in a note under the species in the Manual of N. A. Mosses as "five lobed at base and rather mitrate," is in Dr. Palmer's material usually split open down one side, and at base is more often three or four lobed, this lobing being rather irregular. The calyptra is thus on the whole as in Funaria. This, and especially the presence of an *inner* peristome, makes necessary the transfer of this species of Entosthodon to Funaria; it should be called **Funaria Bolanderi** (Lesq.).—JOHN M. HOLZINGER, *Department of Agriculture, Washington, D. C.*

A probable new category of carnivorous plants.—The fact that members of the genus Polyporus are in the habit of catching and digesting small insects is not generally known. At least after a careful examination of such literature as happens to be at hand, the writer is unable to discover any reference to what is a distinct and curious phenomenon in the life history of some of these large and interesting fungi. In Polyporus applanatus the method of catching and devouring the insects has been studied by me, and a brief description may be in place at the present time. Whether or not the habit alluded to has been described by other students I cannot yet be sure, but it is sufficiently unknown in American writings to permit of attention in these pages.

Polyporus applanatus (Pers.) Wallr. is common around Lake Minnetonka, where it occurs on its ordinary hosts, and also on *Tilia Americana* in considerable abundance. The large size — one-third of a meter in diameter — and the cinnamon-brown zonate upper surface, together with the light under surface and the minute pores make it a conspicuous object in the woods and swamps. This plant seems to exert an attractive influence over various species of small flies — especially when partly grown. The flies may be seen assembling in swarms upon the under surface of the plant, where they walk about and appear to feed upon the soft substance of the hymenophore. Mosquitoes and gnats, together with larger flies, may be found upon the under

surface in large numbers at certain times of the day, notably in the evening or towards the middle of the afternoon. I have not been able to discover any secretion that might be attractive to the insects given off by the plant, but there may be such.

In walking over the minutely perforated surface an occasional fly may be seen to get its feet caught between the clefts and is then unable to extricate itself. It shortly dies and lies flat upon the hymenophore surface. Whether the death is due to poisoning or simply to fatigue, I have not determined. At any rate there is very promptly sent up around the body of the insect a mycelial growth from the interior of the pores of the plant, and in a few hours the insect is completely covered by the fungus filaments. For a time it may be seen as a hummock or elevation on the hymenophore, but shortly, through the absorption of its substance into the tissue of the fungus, it disappears as an elevated area and is discernable solely through its imparting a slightly lighter color to the portion of the hymenium lying around it. I have in my collection one of these Polyporus fruits, about six inches in diameter, with seventeen small flies captured and digested—some of them so completely destroyed that there is scarcely more than a vague stain left to mark the spot where they lay, and others of a whitish hue and lying in high relief on the tinted lower surface. In the case of those that are thoroughly digested the plant produces pores afresh through the remains of their bodies, and the trace of their original presence becomes almost obliterated. Those that are partially digested are not penetrated by the pores but the mycelial covering is of a solid texture. It is quite like that of the border of the hymenophore. Nor do the penetrating pores appear until the flies are reduced almost to the level of the general hymenium surface.

This phenomenon is an interesting one, for it shows how a structure devised for another end may be devoted to an accessory line of work, and may in time come to acquire an accessory function. The Polyporus can not be conceived to derive very marked benefit from the small substance that it is able to obtain from the unfortunate flies, but it is easy to see how such a practice if persisted in might develop into a highly important nutritive habit. It is unquestionably true that the plant derives some nutriment from these flies, for where they fall and raise the level of the hymenium there are more pores produced than at other points of similar size. This would indicate that the habit of fly-catching which is practiced by the Polyporus applanatus might develop into something of real importance to the species.

I shall be glad to hear from others who have noticed this habit in Polyporineæ.—CONWAY MACMILLAN, *University of Minnesota.*

EDITORIAL.

A LIVE MAN is readily distinguished from a dead one, and if the man is alive to some important interest it needs no search light or committee of investigation to make the fact apparent. The statement applies no less forcefully to bodies of men than to individuals. At the recent meeting at Rochester a ninth part of the time occupied by the American Association for the Advancement of Science in its annual sessions was set apart to the exclusive control of the botanists by the establishment of a botanical section. This came about chiefly through the efforts of the non-botanical members of the society, who said that the botanists were so numerous and active, had so many and valuable papers, were such an important element, that it was their due; and so while mathematics and astronomy must share rooms, officers and time, as well as geology and geography and some other subjects, botany has an exclusive portion. It was evident to the Association that the botanists constituted a live body.

That this appearance of activity, which did not escape even those who probably possess but an indistinct notion of the domain of botany, is well grounded, was abundantly demonstrated during the sessions in numerous ways, and in none better than in the action upon the question of a stable nomenclature. In the most business like manner, and with an enthusiasm, directness and good feeling which would have done credit to any deliberative body, the question that for years has been supposed to endanger the rational progress of the science and in the hands of the more youthful and radical advocates threatened to plunge American botany into chaos, was taken up, discussed, the most important features formulated and agreed to, a delegate to the convention at Genoa appointed, the money to defray his expenses subscribed, and the mission to secure the co-operation of the botanists of Europe begun before the session at Rochester had closed. The results of the Congress at Genoa have been most satisfactory, and are especially flattering to the foresight and zeal of American botanists, whose views have received marked consideration.

There is, therefore, no reason to think that the botanists of this country cannot do well whatever they undertake. There is furthermore no reason to suppose that they will shirk a manifest responsibility; and yet they are dangerously near such a point. Whether they desired it or not, the impression has become widely established that a botanical congress will be held next year. The World's Congress Auxiliary attempted to secure the co-operation of the botanists, and offered them the use of the machinery of that organization, including

free publication of their proceedings, but the proposition has been rejected.

To be sure, a committee has been appointed to arrange a program of subjects for next year's meeting at Madison. But no enthusiasm has yet manifested itself. It is, however, certainly true that the circumstances are particularly propitious for the largest, the most cosmopolitan, the most notable gathering in 1893 that botany has ever had in this country. There will be a nnmber of distinguished foreign specialists in attendance, and the fame and benefits of the convention will not be confined within our own geographical borders.

If there is a single botanist, or any number of botanists, who has a suggestion, a word of encouragement to the committee, or any opinion regarding the project, now is the time to give it expression through the journals. Silence means apathy, but what is wanted is enthusiasm.

CURRENT LITERATURE.

Canadian Mosses.[1]

The Catalogue of Canadian Plants has now reached the mosses. The list with its annotations and descriptions of new species makes an octavo pamphlet of nearly 300 pages. Mr. Macoun has been a most industrious collector and the Herbarium of the Geological Survey will need to be consulted now by every student of our moss flora. Since 1861 he has been accumulating the material which is here elaborated. 953 species are listed, and numerous varieties, a considerably greater number than were included in 1884 in Lesquereux & James Manual for the whole of North America.

It is unfortunate that Mr. Macoun was not more cautious in the choice of bryologists to work up these rich collections. Undoubtedly he has found many new species; but no one can believe that 237[2] out of 953 are previously undescribed! Both Kindberg, who has been his chief collaborator, and Müller are looked upon by the best bryologists as too much inclined to establish species upon insufficient material and slight differences (to put the case mildly). Indeed the catalogue itself bears abundant evidence of this tendency.

A comparison of the determinations of the centuries of Canadian.

[1] MACOUN, JOHN and KINDBERG, N. C —Catalogue of Canadian Plants. Part VI. – Musci, (Geological and Natural History Survey of Canada.) 8vo pp. viii, 295. Montreal: printed for the government by W. F. Brown and Co. 1892. —25 cents.

[2] Fide Mrs. E. G. Britton in *Bull. Torr. Bot. Club.*

Musci, many of which were named by Kindberg, with the names given in this list shows gross carelessness either at one time or the other. The definitions of the alleged new species, nearly one-fourth of which are sterile, are inexcusably bad. They are so brief, unsystematic, comparative, and in such bad English that it is doubtful if the plants intended can be identified without a re-study of the nearly inaccessible types. For although Mr. Macoun states that "a duplicate of every specimen sent to Dr. Kindberg has been mounted and placed in the herbarium of this department" these cannot be considered the types, however helpful they may be.

Altogether we must conclude that what might have been a work of the greatest value to American bryologists has its good distributed through a heap of rubbish which somebody must sort over before the good can be separated from the bad. For there is much that is valuable, and the indefatigable industry of the Canadian Botanist cannot be rendered entirely nugatory by the poor judgment of his European collaborators.

Contributions from the National Herbarium.

The latest of these was issued September 20th, and forms No. 5 of the first volume. Its contents are as follows: 1. List of plants collected by Dr. Edward Palmer in 1890, on Carmen Island, by J. N. Rose. This island is in the lower part of the Gulf of California, 120 miles south of Guaymas, and, so far as known, has been botanically explored only by Dr. Palmer. The Flora is almost identical with that of the near-lying Californian peninsula. Of the 68 species known to the island, but 7 are thought to be endermic, 5 of which are described in the present paper, 3 of them being illustrated by full page plates. 2. List of plants collected by the U. S. S. Albatross, in 1887–'91, along the western coast of America, by J. N. Rose, D. C. Eaton, J. W. Eckfeldt, and A. W. Evans. This part contains six divisions: (1) List of plants from Cocos Island, by J. N. Rose. This island lies about 500 miles southwest of Panama. (2) List of plants from Galapagos Islands, by J. N. Rose. The plants of these famous islands were first collected by Darwin. (3) List of Ferns, from southern Patagonia, by D. C. Eaton. (4) List of Mosses, from Fuegia and Patagonia, by D. C. Eaton. (5) List of Liverworts from Southern Patagonia, by A. W. Evans, with two plates. (6) List of Lichens from Southern Patagonia, by J. W. Eckfeldt. 3. Revision of the North American species of Hoffmanseggia, by E. M. Fisher. The author enumerates 17 species, with full synonymy and range. The H. falcaria group is recognized in its polymorphic character, and 5 varieties of it proposed. Three new

species are described, and the whole revision gives evidence of a very painstaking work. 4. Systematic and alphabetic index of new species of North American Phanerogams and Pteridophytes, published in 1891, compiled by Josephine A. Clark. This index supplies a very great desideratum, and is properly supplied to botanists by the government. There is also in preparation an index covering preceding years back to 1885, and the promise is given hereafter of an annual index. It is startling to find that a list of the new species of North American vascular plants published in a single year occupies nearly 24 pages, but the number is very much reduced when it is noticed that all changes in nomenclature which have involved new combinations are included. The Division of Botany has put students of systematic Botany under great obligation in preparing this index and in promising its continuance.

NOTES AND NEWS.

REV. F. D. KELSEY, of Helena, Montana, has accepted the chair of Botany at Oberlin College. He is to spend the winter and spring at Harvard University.

DR. R. CHODAT, Professor of Botany at the University of Geneva, Switzerland, desires copies of papers written by American botanists for the library of the university.

THE FUNGOUS DISEASES OF IOWA CEREALS are briefly treated by Prof. L. H. Pammel, especially the rusts and smuts, in a recent Bulletin (No. 18) of the Iowa Experiment Station.

PRESENTATION EXERCISES were held October 15th, by the botanical seminary of the University of Nebraska, when a bust of Darwin was placed in the Herbarium of the University.

MR. J. B. FARMER, for some time past demonstrator of botany at Oxford University, has been appointed assistant professor of botany at the Royal College of Science in South Kensington, as successor to Dr. D. H. Scott, who has gone to the Jodell Laboratory at Kew.

IN A handsomely printed pamphlet of 78 pages, Professor J. E. Humphrey gives a very interesting account of "Amherst Trees." The work is designed primarily for the citizens of Amherst, but it contains much valuable information for the general reader, and notes that will be of use to the professional botanist.

THE CAUSES of electrical disturbances in the plant have been investigated by Otto Haake (Flora, 1892, pp. 455-487), who finds that respiration and carbon-dioxide assimilation are chiefly concerned, while the movement of sap, as Kunkel believed (Arb. d. bot. Inst. zu Würzburg, ii, p. 1), has but little to do with it.

IN THE *Scientific American* (Sept. 3rd) is the description, by W. T. Davis, of a new hybrid oak found upon Staten Island. It is a hybrid of Q. nigra and Q. ilicifolia, and is named Q. Brittoni. It is further commented upon, and tracings of leaves given in the Proceedings of the Nat. Sci. Ass., of Staten Island, for September 10th.

THE MARRIAGE of Mr. O. F. Cook and Miss Alice Carter occurred on October 11th. Mr. Cook is well known to all students of hepatics through his distribution of Hepaticæ Americanæ in conjunction with Dr. Underwood. Miss Carter is also a botanist who has recently made contributions to botanical literature in the field of pollination and color of flowers.

A DISEASE OF POTATOES, in which the stems turn brown at the surface of the ground, and the whole plant soon dies, has been observed in France, and found by MM. Prillieux and Delacroix (Compt. rend., cxi, p. 208) to be due to a microbe, which they name Bacillus caulivorus. The disease can be transferred to geraniums, beans and lupines, but not to other plants.

M. A. FRANCHET, in *Journal de Botanique* (Sept. 16), describes the species of Lilium from China and Thibet represented in the herbarium of the Muséum de Paris. The study is especially difficult on account of the long interference of man with these showy flowers, and it becomes well nigh impossible to determine original forms. However, 24 species are described, 10 of which are new.

ACTA PETROPOLITANI (Tom. XI. fasc. ii), 1892, contains the usual amount of interesting material concerning the Asiatic flora, a flora of special interest to North American botanists. The Apetalæ of the Radden collection are presented by F. Herder; seventh to tenth decade of new Compositæ, by C. Winkler; and descriptions of many other new plants by Batalin, Korzchinsky, and E. Regel.

A REVIEW OF THE SUMMER SCHOOL movement in the University of Minnesota is given in the last *Quarterly Bulletin* of that institution. Four sessions have been held; in 1881, 1882, 1883 and 1892, with an attendance of 45, 75, 104 and 741 respectively. The botany was given by Prof. C. E. Bessey, in 1881, Prof. J. C. Arthur in 1882, and Prof. Conway McMillan in 1892. Botany was omitted in 1883.

BOTANY PARTAKES of the renaissance that characterizes the present administration at Brown University. The Freshman class numbers 140; the Woman's Adjunct, 40. Professor Bailey now has in his department 92 students in all. The president proclaims himself an "apostle of botany." In his annual report he declares the present accomodations of the department "ludicrously inadequate."

During the vacation an attempt has been made to improve, by painting the halls, the introduction of water, new cases and tables, the general outfit of the little laboratory. The room, however, is so small, that the professor is compelled to take the larger class sections into other buildings. There is a good outfit of microscopes and re-agents. Mr. W. T. V. Osterhout, of the Senior class, has spent the summer in study at Wood's Holl, and acts as demonstrator in the advanced classes. A new building to accommodate the lecture rooms, laboratory and herbarium is a crying necessity.

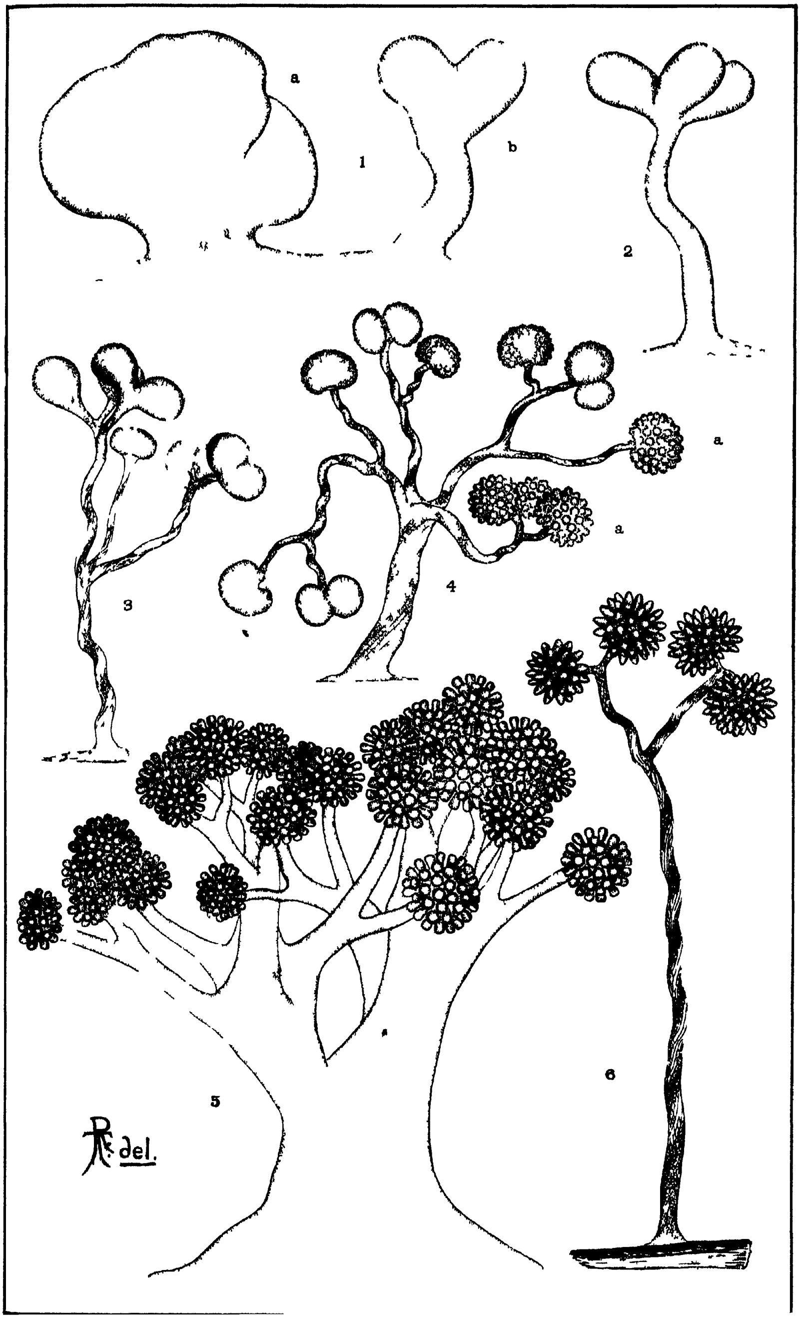
THE MORPHOLOGY OF THE FLOWER of Anthoxanthum has been studied by Mr. Theo. Holm in malformed flowers found in the Smithsonian park, at Washington, D. C. The subject forms an illustrated article in the Proceedings of the National Museum (xv, p. 399), in which the conclusion is reached "that the two awned glumes inside the proper empty ones really belong to two neutral flowers, and that the perfect flower has both a flowering glume and a palet, thereby not being terminal but lateral."

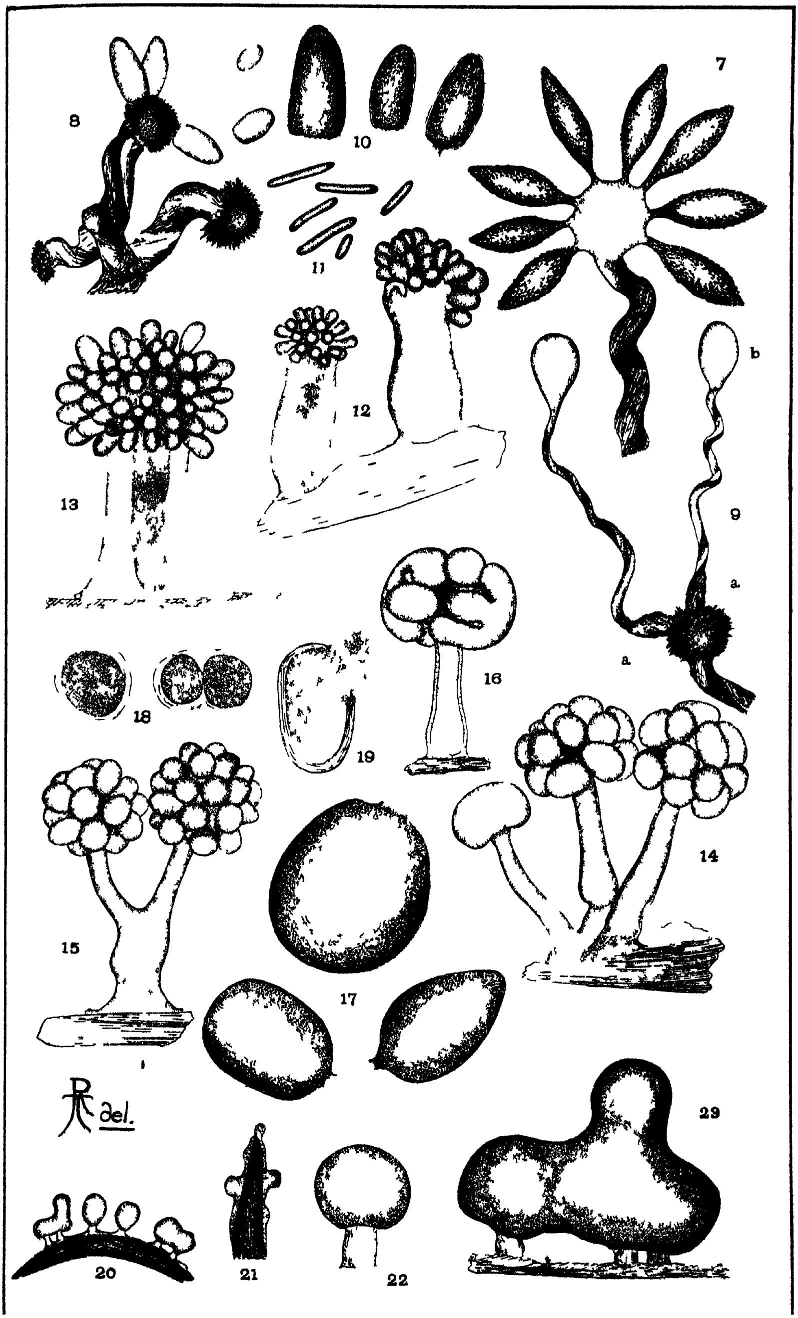
THE *Journal of Botany* for October contains the description of a new Ranunculus from W. Scotland, allied apparently to R. Flammula. Mr. Baker's Synopsis of Malveæ continues with species of Sida, this number containing 6 new species. The Rev. W. Moyle Rogers also continues his "Essay at a Key to British Rubi", which if successful will be a great relief to British botanists. Mr. George Massee also pays his respects in a sprightly fashion to Mr. G. Romanes, in a review of his "Darwin and after Darwin."

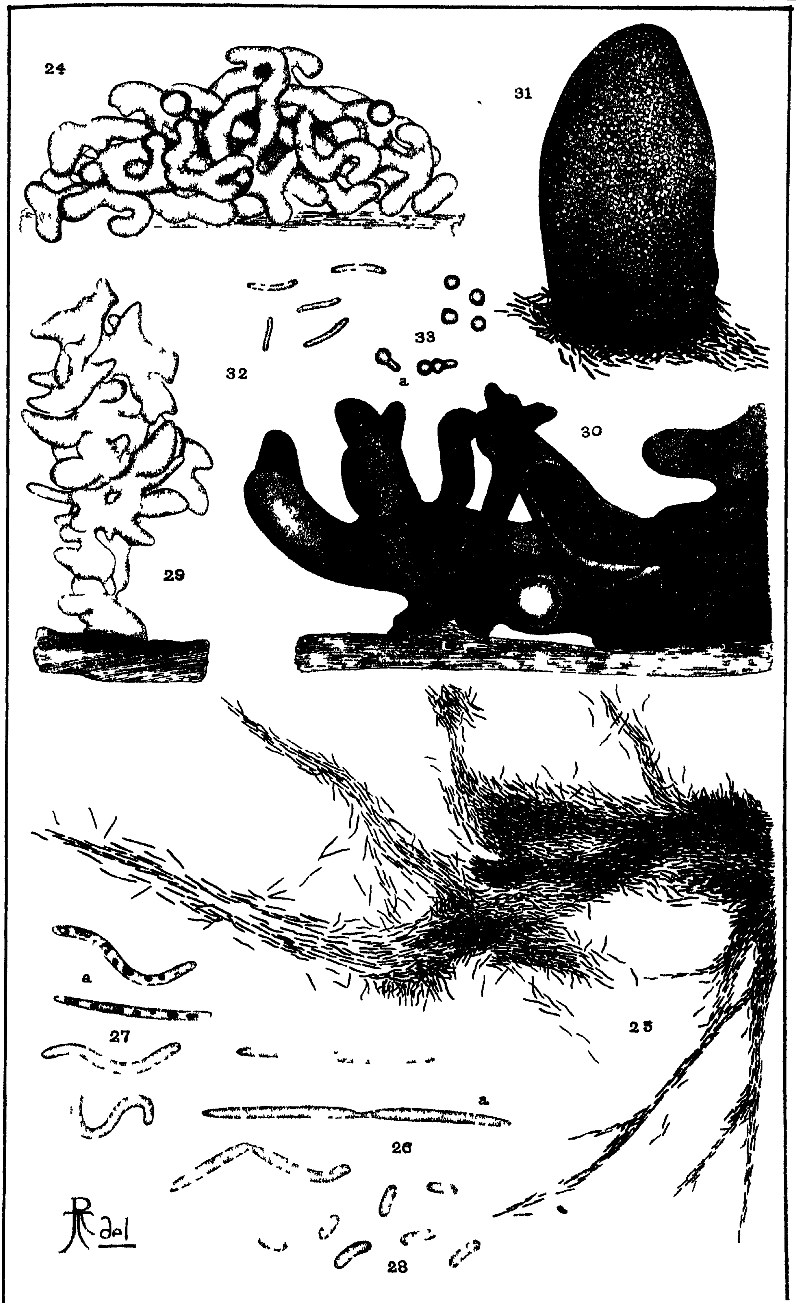
THE VOLUME OF PROCEEDINGS of the American Association for the Advancement of Science, for the year 1891, has recently been distributed. Besides the presidential and vice-presidential addresses of Prof. Geo. L. Goodale and Prof. John M. Coulter, which are printed in full, there are eighteen botanical papers, all but two in the form of very brief abstracts, often consisting of only a few lines. The papers by Professors Bessey and Beal, on transpiration and movement of water in plants, cover four pages each.

THE SECOND REPORT upon electro-horticulture (Cornell Univ. Bull., No. 42), by Prof. L. H. Bailey, firmly establishes the commercial value of the electric light for certain winter crops, especially for lettuce. Certain kinds of plants, which are injured by the direct rays of the light, are not injured, and may even be benefited, when the light passes through a clear glass globe, or through a glass roof. Auxanometric records appear to show that the light accelerates growth, but does not change its normal periodicity.

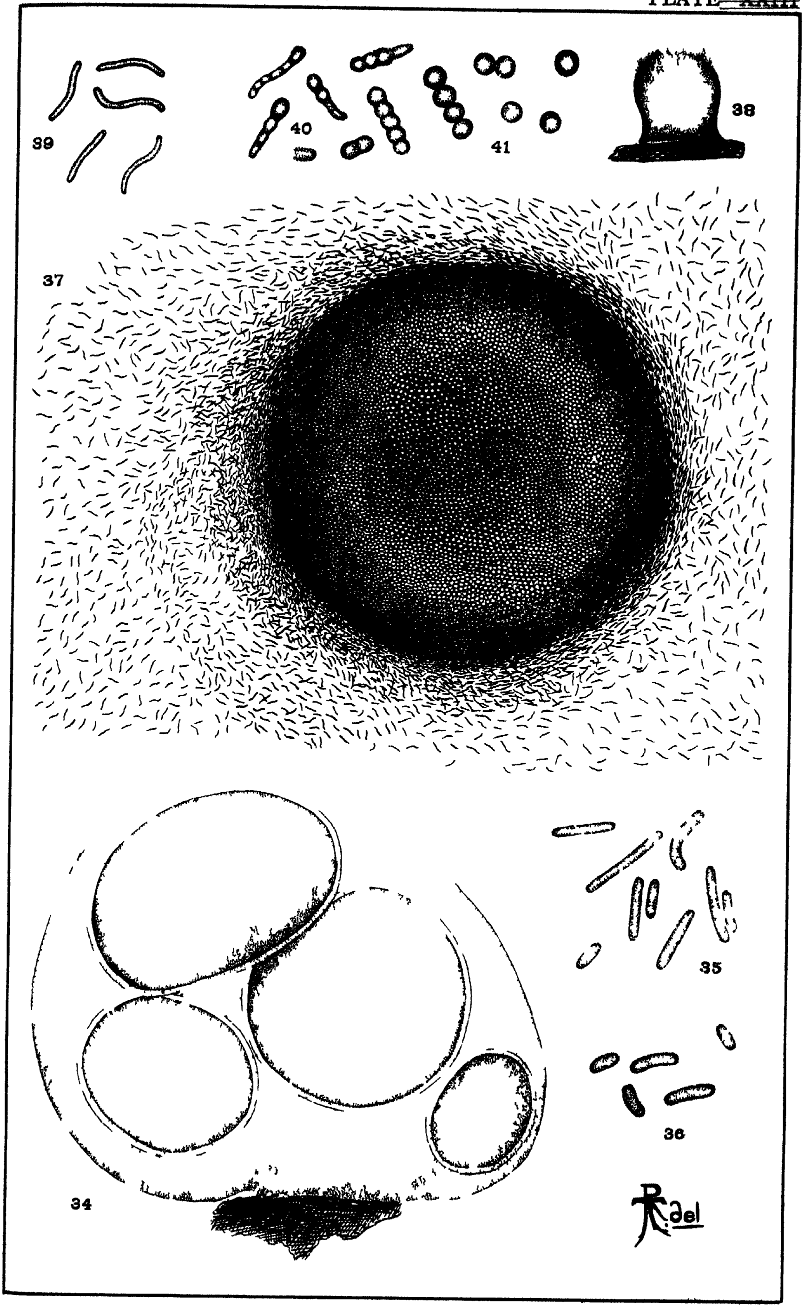
IN THE *Annals of Botany* (July, 1892) J. Bretland Farmer calls attention to a remarkable abnormality in the development of the ovule of *Pinus sylvestris*. He has discovered two distinct endosperms or prothallia in the ovule. The prothallia are separated by a well-marked wall which runs obliquely between them, and is continuous with the wall of the cavity containing them. Both prothallia have pefectly developed archegonia. This clearly indicates that two macrospores have been developed instead of one. Mr. Farmer suggests that this might have arisen by each of the two cells into which the embryo-sac-mother-cell divides, developing into a prothallium, where normally only the lower so develops. Or, as in certain other Coniferæ (as Thuja) in which several mother cells are differentiated, but only one macrospore normally reaches maturity, two independent mother cells may possibly have developed into prothallia.


a
1
b
2
3
4
a
a
5
6
R del.


7
8
10
11
12
13
b
9
a
a
16
18
19
14
15
17
del.
23
20
21
22


24
31
32
33
a
30
29
a
27
25
a
26
28
R del

XXV
PLATE ~~XXIII~~



BOTANICAL GAZETTE.

DECEMBER, 1892.

Contributions from the Cryptogamic Laboratory of Harvard University. XVIII.

On the Myxobacteriaceæ, a new order of Schizomycetes.

ROLAND THAXTER.

(WITH PLATES XXII–XXV.)

A few years since, while collecting fungi at Kittery and in several other localities in New England and the southern states, the writer's attention was attracted by a bright orange-colored growth occurring upon decaying wood, fungi and similar substances, which, although in gross appearance it seemed somewhat highly organized, was found, when examined in a presumably mature condition, to consist of apparently amorphous material, without signs of hyphæ or spores of any kind. Its general appearance and the character of the substance which composed it suggested an immature condition of some myxomycete which had become dried while in the act of rising from the substratum to form its fructification, and on this supposition the material was laid aside until attention was again drawn to it by the occurrence on tree lichens in New Haven, of a closely related organism, which, when artificially cultivated, yielded immature conditions that rendered its true nature apparent. In addition to the two forms just mentioned, the writer has, during the past year, been fortunate in obtaining and cultivating several others having a similar life history, and it is upon these observations that the present paper is based.

This life history, which in several cases has been ascertained by the direct observation of pure cultures made upon sterilized media, is so peculiar, and corresponds so closely, despite the considerable differences which distinguish the more simple from the more highly differentiated forms, and is altogether so unique in the group of Schizomycetes, to which they should undoubtedly be referred, that their separ-

ation as a distinct order seems unavoidable. To the members of this order the writer proposes to give the name MYXOBACTERIACEÆ, for reasons which will become apparent if we consider for a moment the more important stages in their development.

It should first be noted that the life history of these organisms shows a distinct and more or less regular division into two periods; a period of vegetation and, under favorable conditions, a period of fructification or pseudo-fructification: but while the first period is essentially similar in all the forms observed, the second presents remarkable variations.

In the first instance a swarm or collection of rod-like bodies, derived from the successive division by fission of one or more primary individuals, always distinct from one another, possessing a power of slow locomotion and secreting as they multiply a firm gelatinous base which connects the colony as a whole, constitutes the vegetative condition of the organism. This vegetative state continues for a variable but distinct period of time, and in the different forms is characterized by slight variations in the grouping of the individuals composing it. In some cases these may be collected in radiating strands or concentric ridges, or again may be distributed evenly throughout the colony, which in all cases, when growing on a solid medium, possesses a clearly defined advancing edge or border, produced by a heaping up of active individuals in this position. The colony continues to extend itself in this fashion while the conditions remain favorable for its growth; but in the meantime the individuals within this advancing border, having increased rapidly by fission for a certain period, begin to swarm together at different points, often with a characteristic circular tendency in their motion. This piling up of individuals at definite points marks the beginning of the second period just mentioned, which has for its object the production of a resting state.

In the simpler forms, these masses, having raised themselves above the substratum in the form of papillate projections, become rounded off and may be directly encysted without further differentiation. A gelatinous envelope becomes hardened about them to form a protecting wall, within which the encysted individuals are capable of withstanding unfavorable conditions for a protracted period.

From such a simple type as that just described the forms

examined show various degrees of complexity, which reaches its maximum in a most remarkable organism, apparently identical with the supposed fungus described by Berkeley and Curtis under the name of *Chondromyces crocatus*. In this instance we have, following a period of purely vegetative activity, the same swarming together of individuals at different points in the colony; but the masses thus formed, instead of rounding themselves and becoming directly encysted, as in the previous instance, continue to rise vertically from the substratum into the air. The base of the rising mass becomes constricted; the constricted portion is gradually modified into a slender supporting stalk, formed partly of individuals left behind and partly from a gelatinous substance secreted by the mass as it rises. We have then a mass of individuals rising vertically on a slender stalk secreted from its base. This stalk may remain quite simple, or through the division of the mass into two or more lobes, may become successively several times branched, each lobe rising as a distinct mass on a secondary stalk of its own. Finally a condition is reached in which the stem or cystophore, as it may be conveniently called, is terminated by one or more rounded masses of very similar dimensions, in number corresponding to the ultimate divisions of the cystophore, and from these masses arise the cysts which perform the function of reproductive bodies. The cysts first appear as papillate projections covering the surface of each ultimate mass (fig. 4, *a*). The papillæ then become constricted at the base, as the rods composing the mass migrate into them, and assuming at first a fusiform shape, are finally converted in subconical cysts of very regular size and form. The cysts are caducous at maturity, falling from their attachment at the slightest touch, and are disseminated through the air like the conidia of many fungi, which they closely resemble. After a period of rest, and under favorable conditions, the rods make their exit simultaneously from the cyst, leaving behind an empty shell and enter at once upon a new vegetative period; or sometimes, while still *in situ*, proceed to form a secondary cyst (fig. 9, *b*).

Such are the extreme variations in the group, so far as concerns the differentiation of the cyst-producing generation. There appear to be, however, other important differences which divide the forms rather sharply in connection with the

modification of the individual rods at the period of encystment. For while in one group (Myxococcus), they become transformed into definite spores, in the other (Chondromyces and Myxobacter), the rods are encysted as such with little apparent modification, as far as the writer has been able to ascertain.

Without entering into further details of structure or development, which will be found below, sufficient has been said to make intelligible a brief comparison between the course of development of these plants and that of other organisms which may seem to possess certain characteristics in common with them.

The general character and structure of the rod-like individuals, together with their vegetative multiplication by fission, renders their schizomycetous nature as individuals a matter hardly to be doubted: but, on the other hand, the question may fairly be asked whether the remarkable phenomena which they present, not as individuals, but as aggregates, may not indicate a possible relationship in other directions. In the account just given it is hardly necessary to point out the evident similarity between the course of development described and that which occurs in the Mycetozoa, and more particularly in the Acrasieæ. In no other group, as far as the writer is aware, does there exist a similar concerted action of aggregates of individuals towards a definite end, namely, the production of a more or less highly differentiated resting state. Setting aside for the moment the fundamental differences presented by the cell characters in either group, the vegetative condition of the Acrasieæ and that of the Myxobacteriaceæ may be considered strictly comparable. In both cases multiplication by bipartition, followed by the complete separation as individuals of the two parts thus formed is followed in turn, after a period of successive bipartitions, by a swarming together of distinct individuals into aggregates of distinct individuals having a definite end in view. Apart from differences of cell structure, therefore, the essential characters of a pseudo-plasmodium are common to both groups.

Following the analogy to later stages of development a certain similarity may be noted between the steps which lead in either case from the simpler to the more complicated forms. In both instances a transition is observable from a mere heap-

ing together of individuals to form a resting state, to the production of a similar state, developed in a more complicated fashion and raised upon a highly differentiated stalk, through intervening forms, in which this stalk appears merely as a supporting base.

The most essential discrepancy which is apparent in such a comparison rests on the fundamental difference in cell structure already referred to, since although the Acrasieæ have taken a decided step away from the true Myxomycetes in the production of cells which neither coalesce nor produce pseudopodia (as in the Guttulinaceæ), the step from such amœboid cells to definite rods having all the characteristics of typical schizomycetous cells is, to say the least, a very long one. This fundamental difference necessarily involves equally important differences connected with the modification of individuals, in either case, while in the resting state, even when a definite spore formation takes place in both instances; while the encystment of numerous individuals to form a spore-like body, in the manner above described, presents an additional point of deviation in this connection.

In view of such important differences, the writer would hesitate to assume even a remote genetic connection between the two groups on a basis of resemblance which might well be purely accidental. Yet it is a question to which further investigation in this direction may afford a more definite answer, whether the evidence at hand may not show the necessity of still greater caution in accepting the views of those who would unceremoniously relegate the Mycetozoa to the domain of pure zoology: since, other matters apart, we find in the present order a characteristic at least very similar to that which has been held to constitute a crucial difference between the Mycetozoa and any known group of *plants*, namely, the occurrence in their developmental history of phenomena closely resembling those presented by plasmodia or pseudoplasmodia—not an indiscriminate heaping together of individuals as a result of merely vegetative processes, but a definitely recurring aggregation of individuals capable of concerted action towards a definite end, an end which finds its accomplishment in the production of a more or less highly developed resting state.

Whatever its true affinities may prove to be, however, the order is undeniably a very interesting and important one,

and although the present account is necessarily incomplete, it may serve to call attention to a subject which, beyond question, offers a productive field for further investigation.

Historically the story of the group is not a long one, yet is instructive in showing the absurdities to which the careless and wholesale description of new species may lead. *Chondromyces aurantiacus*, for example, has, if the writer's conclusions are correct, been placed in three separate genera of hyphomycetous fungi, although possessing no trace of hyphæ or of spores, the slight striation of the shrunken cystophore in the one case and the general external appearance of the cysts or of their contents in the other, having been made to assume these functions for descriptive purposes. The same is also true to a less degree of *C. crocatus*, although from its apparent rarity it seems to have escaped an extended synonymy. Whether any of the other forms enumerated below have been previously described the writer is unable to say; yet it seems very improbable that the spores of such common and conspicuous forms as *Myxococcus rubescens* and *M. virescens* should have escaped description, at least as chromogenous micrococci. The species of *Cystobacter* Schröter seem with little doubt to belong to the present family, and should probably be referred to *Chondromyces*, possibly *C. aurantiacus*, which in artificial cultivation produces a variety of abnormal forms and becomes "kastanien braun" when kept moist for a certain period. The descriptions of Schröter, however, are not sufficient to render any definite conclusion possible in the absence of proper figures.

MYXOBACTERIACEÆ.

Motile, rod-like organisms, multiplying by fission, secreting a gelatinous base, and forming pseudoplasmodium-like aggregations before passing into a more or less highly developed cyst-producing resting state, in which the rods may become encysted in groups without modification or may be converted into spore masses.

GENERAL CHARACTERS.— The vegative rods present but slight variations in size and form in the different genera and species. In all cases they are typically elongate, sometimes attaining a length of 15μ and, while living, show a tendency to taper slightly towards either extremity which disappears when they are killed, the ends becoming

bluntly rounded. The cell wall is highly elastic and surrounded by a barely perceptible gelatinous layer, while the cell contents may usually be seen to contain distinct granular masses (fig. 27, *a*) of irregular size and shape which stain more deeply than the remainder of the cell. Cell division follows an elongation and nearly median constriction of the rods which, except at the moment of division, are always separate, never united in chains. A slow, though distinctly visible movement characterizes the active rods and consists in a sliding locomotion in conjunction with a lateral bending. This lateral movement, which may take place in any plane, may be carried to such an extreme that the rod may form a loop with its ends approximated, after which the normal straight position may be assumed with considerable rapidity. This bending movement is doubtless an important factor in the sliding locomotion which though barely perceptible, can be definitely ascertained by careful watching.

The grouping of rods in a colony may vary somewhat in different species and under different conditions. In *Chondromyces aurantiacus*, for example, they may, when growing in a semi-liquid medium, show a tendency to radiate from a common center in rope-like, anastomosing strands, while on a solid medium these strands may form ridges, the alternate elevations and depressions in which may give the colony a characteristic corrugated appearance. In other cases, as for example in Myxococcus, the rods may show less tendency to collect together, remaining more or less evenly distributed until just before the period of spore formation. In all cases the individuals of a colony are heaped together in the region of its advancing margin which is distinctly elevated above its surroundings, and characteristically roughened by great numbers of partly free individuals projecting from its surface. In all species, with one exception, the rods when seen in masses, are more or less distinctly reddish. This color may, however, be lost as the mass rises to form cysts, as is the case in *C. crocatus* as well as in *Myxobacter aureus.*

A distinct, firm, hyaline, gelatinous base is secreted by the colony as it extends itself, over which the individuals may move or in which they may become imbedded, and is so coherent a structure that whole colonies may be stripped intact by means of it, from the surface of nutrient agar, for example. At the period of cyst formation it is often left

behind as a distinct shining membrane in which a few rods remain here and there imbedded.

The duration of the vegetative period varies according to circumstances. In artificial cultures it usually lasts about a week or even two weeks; but in nature the production of cysts must certainly be more rapid. In *Chondromyces lichenicolus*, for example, a period of moist weather following continued drought, and lasting not more than two or three days is sufficient to cover the previously dry tree trunks on which it vegetates with large patches of cysts.

The preparations for the production of cysts are apparent to the naked eye in artificial cultures of *C. crocatus*, for example, about a day before the cystophores begin to rise. In this condition the colony even in the neighborhood of its advancing edge, assumes a lumpy appearance owing to the aggregation of rods at various points. In forms like Myxococcus, in which the rods are somewhat scattered, the first preparation for spore production as seen under the microscope consists in the appearance of groups of rods moving with a circular tendency and forming whirlpools, so to speak, in which the more central individuals soon become converted into spores, the successive formation of which results in the production of the elevated spore masses characteristic of the various forms.

The formation of a cystophore where it occurs results from the basal constriction of a papillate mass of rods which projects from the surface of the colony. The mass of rods moving upwards on one another, continually leaves behind and below it an external layer at its base which has become slightly hardened by exposure to the air and is composed partly of the gelatinous matrix, partly of individuals which soon become indistinguishable in it. As the mass rises within and above this slightly hardened layer, the latter, while being constantly renewed above, becomes contracted below to form the cystophore. The cystophore may therefore be compared during its formation, to a glass funnel, the flaring portion of which is being constantly renewed from the outer surface of the mass of rods contained within and rising above it, while the tubular portion is being constantly lengthened by the contraction of the flaring portion at its base. As the freely moving individuals pass up out of the upper portion of this tube it is left behind as a gelatinous structure which becomes

indurated and solid, its strength being often further increased in slender forms by a decided spiral twist.

This primarily tubular character of the cystophore is well shown in specimens of *C. aurantiacus* when cultivated with very moist surroundings. In such cases even after the cystophore has attained its full height a central clearly differentiated column of active individuals may be seen moving up to the cysts which are in process of formation at its summit (fig. 13). In its development the cystophore shows all degrees of complexity from the short supporting base (which may be wholly absent) of *C. lichenicolus*, to the elongate form in *C. crocatus* which may produce branches of the fifth or even sixth order.

In considering the encysted condition of these organisms, two distinct categories are recognizable in connection with this state, one in which the individuals thus encysted show little or no modification from the rod-like vegetative state, the other in which they are converted into definite spores.

In the first instance the form of the cyst varies considerably presenting in the genus Chondromyces the series illustrated by *C. serpens*, *C. lichenicolus*, *C. aurantiacus* and *C. crocatus* (figs. 24, 23, 22, 15, 14 and 6) and may be further modified by a more or less complete fusion of adjacent cysts originally distinct (figs. 24, 23, 16). This fusion may result in the anastomosing coil characteristic of *C. serpens* or may consist in a mere lateral adherence of two neighboring cysts as in *C. crocatus*. The degree of encystment also shows considerable variation in the series just mentioned and reaches its highest development in *C. crocatus* in which the distinction between cyst wall and cyst contents is clearly marked. The cysts of Myxobacter present an additional peculiarity in that the very large thick walled cysts are themselves involved in a gelatinous matrix which dries in the form of a tough general envelope.

The substance of these cysts, composed partly of rods and partly of a firm and surprisingly coherent matrix, appears at maturity even when examined under a high power of the microscope, to be composed of stringy amorphous matter which is separated by crushing with the greatest difficulty. It is only by the closest examination and the use of staining agents that the presence of any definite bodies whatever within such cysts can be made out. Here and there the closely adhering

rods may be separated and isolated by crushing; and in this condition they show little modification from the vegetative state except that they are somewhat shorter and thicker. In a few cases rods have been observed within the cysts in stained preparations in which an apparent differentiation of the rod contents was observable. Whether this appearance was due to the presence of spores or merely indicated an accidental aggregation of the granular cell contents was not determined.

For a short time after the cysts are mature and also before they germinate after a period of rest, the contained rods are clearly defined and do not adhere closely to one another. The contents of such a cyst when crushed makes its exit as a mass of distinct rods somewhat shorter and thicker than the vegetative forms.

In "germination" the cysts emit their contents in a continuous stream which finally leaves the cyst wall as an empty shell, the emission being effected through the absorption of a portion of the cyst wall, usually at the base in the spore-like forms, sometimes at the apex or elsewhere. The mass of rods thus freed begins at once to vegetate, the individuals dividing rapidly and entering upon a new period of activity. Exceptions to this course are often found in old cultures of *C. crocatus* where cysts that have germinated *in situ* at the tips of the cystophores may frequently be seen producing secondary cysts directly, which are borne on short, slender secondary cystophores (fig. 9), a circumstance which still further illustrates the remarkable though superficial resemblances which exist between these forms and higher fungi.

In the sporiferous species, which have been included in the single genus Myxococcus, there may be a general encystment of the spore mass into a definitely formed coherent structure, as in *M. coralloides*, or this structure may normally become soft and semi-fluid through the deliquescence of the gelatinous matrix in which the spores are imbedded, as in *M. rubescens* and *M. virescens*. The spores are more or less irregularly spherical refractive bodies, the diameter of which is much greater than that of the rods from which they are derived, the difference being most remarkable in *M. rubescens* and *M. virescens*. The method by which the spores are derived from these rods has not been ascertained by continuous observation, since sporulation only takes place at the period when

the rods swarm together for this purpose and then only in the central region below the rising mass of spores which, together with the aggregation of rods around it, completely conceals the details of transformation when viewed directly under the microscope. By crushing such masses, however, the steps by which the spore-production is effected may be inferred from the occurrence, here and there in the swarm of unmodified rods and spores thus separated, of forms similar to those represented in fig. 40. Such forms would indicate that the rod, by division following simultaneous or successive enlargement throughout its whole length, is directly converted into spores varying in number according to the length of the rod; and in the absence of any indication of a different process this may be assumed to be correct. This conclusion is further supported by the very frequent occurrence in such preparations of chains of spores adhering in twos, threes or even fives (fig. 41).

The germination of these spores has not been observed to the writer's satisfaction; but appears to consist in a gradual transformation from the round to the rod-like form. Whether an external membrane is left behind in this process could not be determined.

The nine species which constitute the family so far as at present known, may be arranged under three genera, as follows:[1]

CHONDROMYCES B. & C. (1857), in Berk. Introd. Crypt. Bot., p. 313, fig. 70, a (no descr.) 1857. do. in Grevillea III. p. 64 (first descr.) 1874.

Stigmatella: B. & C in Berk Introd Crypt Bot, p. 313, fig. 70, b (no descr.) 1857. do. in Grevillea III, p 97 (first descr)

? *Polycephalum:* Kalch & Cke in Grevillea IX, p 22, 1880.

? *Cystobacter:* Schroeter in Kryptogamen-fl v. Schlesien III, I, p 170.

---

[1] NOTE — In considering these forms from a systematic point of view the writer has preferred to avoid the multiplication of genera and species; since the true value of generic and specific distinctions in a group so little known in these respects, is a matter which can only be settled satisfactorily by a wider knowledge of the remaining forms, which undoubtedly exist. For this reason it has not been thought advisable to separate generically members of the series included under Chondromyces, the connection between the extreme forms (*C. crocatus* and *C. serpens*) being so well illustrated by the remaining species. Again, the deliquescent guttulae which constitute the spore masses of *Myxococcus rubescens* and *M. virescens* and the definitely coherent structure found in *M. coralloides* are very different in character, yet in the absence of further data as to species a generic discrimination of these forms seems inadvisable. The writer recognizes the fact, however, that further information may modify the arrangement adopted not only in regard to genera and species, but also in connection with the division of the groups as a whole, which might properly be divided into two definite sub-families based upon the peculiarities of the resting condition.

Rods forming free cysts, in which they remain unmodified. Cysts various, sessile or borne on a more or less highly developed cystophore.

CHONDROMYCES CROCATUS B. & C. Plates XXII, XXIII, figs. 1–11.

Chondromyces crocatus: B. & C. in Berk. Introd. Crypt. Bot. p. 313, fig. 70, a (no descr.) Berkeley in Grevillea, III, p. 64 (descr.) Cooke in Bull. Buff. Soc. Nat. Sci. III, p. 192. Saccardo, Sylloge Fungorum IV, p. 576.

Aspergillus crocatus: B. & C. in herb. Curtis, and herb. Berkeley (*sec.* Farlow).

Colonies pale orange red. Rods cylindrical or tapering slightly straight or slightly curved, 2.5–6× .6–.7μ. Cystophore orange colored, slender, simple or 1–5 times successively branched, striate, spirally twisted or irregularly bent; average height 600μ, rarely 1 mm. Cysts pale straw colored, at first fusiform, at maturity sub-conical, rounded at the apex, often ragged at the base. Average dimensions 28×12μ (15–45×6–20μ), in variable numbers at the tips of the cystophore where they form globose heads, 70–90μ in diameter.

South Carolina, *Ravenel*, in herb. Curtis and herb. Berkeley, on decaying melon rind. Cambridge Mass., on old straw.

The specimens of this plant in the Curtis collection correspond in all respects with the Cambridge material which made its appearance on some old straw sent from Ceylon, and has been kept in cultivation in the laboratory, growing readily on nutrient agar and luxuriantly on sterilized horse dung. According as the substratum is moist or dry the general habit may vary considerably, excessive moisture often producing considerable irregularity in the form and number of the cysts as well as in the cystophore, which is thicker under these conditions, more irregularly branched and without the spiral or longitudinal striations (due to wrinkles of the surface) usually characteristic of the slender forms.

Cultures of the cysts in Van Tieghem cells have yielded few germinations after several months, but it may be readily observed by placing in a moist chamber a specimen which has been kept dry. By examining such a specimen after one or two days the germinating cysts may be seen in all conditions. At first the contents becomes slightly contracted within the cyst-wall and in it the separate rods may be distinctly seen; then through the absorption of the wall usually at its base, the rods are allowed to make their escape in a continuous stream till nothing but the empty cyst-wall is left behind.

The mature cysts show none of the reddish coloring pecu-

liar to the other species, and as in *Myxobacter aureus* this seems to be lost as the rod-masses rise to produce cysts. Although so conspicuous a form, this species does not appear to have been recorded since its discovery by Ravenel, Cooke and Saccardo merely quoting Berkeley's publication in the references above cited. As a matter of curiosity Berkeley's description is appended.

"*Chondromyces* B. & C. Stipes e floccis compactus ramosus induratus, sporæ apicales.—600. *Chondromyces crocatus* B. & C. On decayed melons. Car. Inf. no. 1335. Stem closely compacted, orange, subcartilaginous, branched, the branches more or less divaricate, nodular at the apex; spores elongate-ovate with a very short pedicel." Grev., *l. c.*

CHONDROMYCES AURANTIACUS (B. & C.)—Plates XXIII, XXIV, figs. 12–19 and 25–28.

Stigmatella aurantiaca: B. & C., in Berk. Intr. Crypt. Bot., p. 313, fig. 70, b. do. Grevillea, vol. III, p. 97. Cooke, Bull. Buff Soc. Nat. Sci., vol III, p. 193. Curtis' Cat., p. 126. Saccardo Sylloge Fung., IV, p. 680.

? *Polycephalum aurantiacum:* Kalchbr & Cke. Grevillea IX, p. 23, pl. 135, fig. 10, a, b, c. (1880). Saccardo Sylloge Fung. IV, p. 576.

? *Stilbum rhytidospora:* Berk. & Broome, on the Fungi of Ceylon, Jour. Linn. Soc. (Botany) XIV, p. 96, plate IV, fig. 16 (1873). Sacc. Sylloge IV, p. 571.

Colonies flesh colored, distinctly reddish. Rods large, tapering somewhat, normally straight, rounded at either extremity $7–15 \times .6–1\mu$, average $7 \times .5\mu$. Cystophore hyaline or flesh-colored, stout, straight, simple or rarely furcate. Average height 200μ. Cysts at first stalked, then sessile, oval to elliptical or rounded in outline, often irregular in size and shape, bright orange colored when dry, becoming chestnut brown when kept moist for a considerable period, borne in variable numbers and forming globose heads at the extremity of the cystophore. Cysts about $30–50 \times 30–75\mu$.

S. Carolina, on *Sphæria Hibisci* (herb. Curtis). N. Carolina, Connecticut to Maine, on decaying wood and fungi.

With the exception of *Myxococcus rubescens* this is the commonest member of the group and must have been met with by any one who has sought for Myxomycetes on decaying wood, where though very minute it is conspicuous from its bright color. Although easily cultivated on nutrient agar, unlike *C. crocatus* it rarely produces well formed cystophores and cysts on this medium, though cultivable on its ordinary substrata without difficulty.

In giving its synonymy, *Polycephalum aurantiacum* K. & Ck. as well as *Stilbum rhytidospora* B. & Br. have been included

with a query. The description and figures given in either case leave little doubt of the correctness of this reference, but a comparison of authentic specimens has not been made. Whether one or both of the forms described by Schroeter under Cystobacter may not prove abnormal conditions of this species is also uncertain; but on very moist media it shows conditions closely resembling his descriptions, and becomes chestnut brown after continued exposure to moisture, thus presenting an additional point of resemblance. Even in its natural substratum cyst formation is subject to great irregularities, especially if the rising rod masses become slightly dry during the process. In such cases the latter may heap themselves together in irregular cyst masses lying directly upon the substratum with little or no differentiation of a cystophore.

The genus Stigmatella, which was founded upon this species, is made by Saccardo to include two species, *S. aurantiaca* and *S. pubescens* Sacc. & Ell., the latter having been formerly described under the name *Sphærocreas pubescens* Sacc. & Ell.* (Michelia II, p. 582.) Although Saccardo remarks concerning this form, "De identitate *Sphærocreatis* cum *Stigmatella* nullum mihi est dubium," it is difficult to see on what this opinion is based; the fungus in question consisting of a rounded mass of large chlamydospores borne terminally on well defined hyphæ and surrounded by a woolly mass of somewhat differentiated hyphæ. It is needless to remark that the two can have no connection, Sphærocreas being clearly a fungus allied to if not generically identical with forms included in the genus *Endogone.*

Chondromyces lichenicolus n. sp.—Plate XXIII, figs. 20–23.—Colonies reddish, rods cylindrical, tapering slightly, $5–7 \times .6\mu$. Cystophore simple, short, squarish, often absent or ill developed, $7–8 \times 10\mu$. Cysts single, rounded or irregularly lobed, often confluent, bright red, $35 \times 28\mu$.

Parasitic on living lichens, which it destroys, New Haven, Ct.

This species has not been met with in any locality other than the one mentioned, where it occurs abundantly on the trunks of the elms and maples along the city avenues, often covering patches several feet in length. The cysts are very irregular in form, often lobulated and laterally confluent, and their crowded habit and deep red color make them very conspicuous. Owing to the shortness of the cystophore, it is seen

with difficulty *in situ*, and seems often to be wholly absent. Specimens kept dry in the herbarium for eighteen months germinate readily when sown on moist lichens, and like other cysts of the group would probably retain their vitality for a much longer period.

Chondromyces serpens n. sp.—Plate XXIV, fig. 24.—Rods as in *C. lichenicolus*. Cysts flesh-colored, dark red when dry, 50μ in diameter, confluent in an anastomosing coil. Cystophore absent.

On decaying lichens, Cambridge, Mass.

This species made its appearance in company with *C. lichenicolus* in a laboratory culture and was at first taken for an abnormal condition of that species. Cultures on agar and on lichens, however, constantly produced the same convoluted form which seems to be quite distinct and differs from all the remaining species of the genus in possessing no cystophore, the mass being sessile upon its substratum, and often reaching a length of more than a millimeter.

MYXOBACTER n. gen.—Rods forming large rounded cysts, one or more free within a gelatinous matrix raised above the substratum.

Myxobacter aureus n. sp.—Plate XXV, figs. 34–36.—Colonies when rising to form cysts milky white. Rods large, cylindrical, rounded at either end, $4-7\times.7-.9\mu$. Cysts spherical or oblong, golden yellow, thick walled, one to twelve or more in number, distinct within a hyaline matrix, $75-350\times75-275\mu$. The encysted rods mingled with a yellow, oily material. Cyst groups .7—1mm. long.

On very wet wood and bark in swamps. Kittery Point, Me., Belmont, Mass.

MYXOCOCCUS n. gen.—Rods slender, curved, swarming together after a vegetative period to form definite, more or less encysted sessile masses of coccus-like spores.

Myxococcus rubescens n. sp.—Plate XXV, figs. 37–41.—Rod-masses reddish, rods slender, irregularly curved, $3-7\times.4\mu$. Spore masses scattered, drop-like, flesh-colored to dull orange, deep crimson when dry, at first coherent, becoming deliquescent, 150μ—1mm. in diameter, often confluent. Spores round, 1.5—1.2μ in diameter.

On various decaying substances, lichens, paper, dung, etc.

This species is so common and makes its appearance with

such constancy on laboratory cultures of horse dung that it seems hardly possible it should have escaped previous description as a chromogenous coccus. The only form which has been described on this substratum to which it could possibly be referred is *Micrococcus fulvus* Cohn[1]. This species appears however, to be a true Micrococcus and, judging from the specimen in Rabh. Alg. Eu. no. 2501, bears little resemblance to the present form. The drop-like masses are at first more or less coherent and may be transferred intact to a slide for examination; but they soon become deliquescent, adjacent guttulæ coalescing into viscous masses more than a millimeter in diameter. The variation from flesh-color to orange-red forms may indicate an additional species, the orange type retaining this tint in agar cultures without varying towards the flesh-colored form. The morphological differences if there are any, are, however, too slight to warrant a specific distinction.

Myxococcus virescens n. sp.—Rod masses greenish yellow. Rods as in M. rubescens. Spore masses clear yellow-green to green, 150–500μ in diam. Spores round, 1.8–2μ in diam.

On hen's and dog's dung, New England.

This species, which closely resembles the last except in color, is rather rarely met with on the substrata mentioned, forming rather smaller spore masses. When cultivated on potato agar it tends to lose its green color and become yellowish. The spores seem constantly larger than in the preceding species.

Myxococcus coralloides n. sp.—Plate XXIV, figs. 29–33.—Rod masses pale pinkish, thin. Rods slender, curved, 4—7 $\times$.4μ. Spore mass firmly coherent, erect, variously branched or lobed, the lobes or branches usually tapering towards the rounded apex, flesh-colored, becoming bright pinkish when dry; maximum height 350μ, the lobes about 20–30μ in diameter. Spores spherical, 1–1.2μ in diam.

On decaying lichens, Cambridge, Mass.

This striking form made its appearance in laboratory cultures and was readily cultivated on lichens and potato agar. The coral-like form of the spore mass is very variable, presenting every imaginable variation from a simple papilla to a complicated structure similar to that represented in fig. 29.

In addition to the species above enumerated the writer has observed several others, among them a very minute and peculiar

[1]Cohn: Beitr. z. Biol. d. Pflan. 1, 3, p. 181.

form occurring on rabbit's dung, belonging to the Myxobacter group, and another on lichens near *Myxococcus coralloides*, but was unable at the time to observe any of them under cultivation. Further additions to the order are therefore certainly to be looked for.

Cryptogamic Laboratory of Harvard University.

NOTE.—**Myxobacter simplex** n sp., for which I accidentally omitted ,to send manuscript will be characterized in the succeeding number.

EXPLANATION OF PLATES XXII -XXV

The figures are drawn with few exceptions from specimens mounted in glycerine. The combinations used are as follows: Figs. 1-6, 12-16, 20-21, 24, 29, 34: Zeiss oc. 4. obj. A Figs 7-10, 17-19, 22-23: Zeiss ocul 4, obj. D. Figs. 11, 26-28, 31-33, 35-36, 39-41 Zeiss comp oc 12, Leitz oil im. $\frac{1}{12}$. Fig. 31: Zeiss oc. 4, Leitz oil im. $\frac{1}{12}$. All figures reduced ½ by photo-litbography.

PLATE XXII.

Chondromyces crocatus (B. & C.)

Fig 1-6 successive conditions of cyst formation shown by as many individual specimens. Fig 1 *a*, mass of rods just rising from substratum and becoming constructed at its base. *b*, smaller mass which has begun to secrete a cystophore and has become two-lobed preparatory to branching. Fig. 2. A more advanced specimen, the mass preparing to produce three branches Figs. 3, 4. Nearly mature cystophores showing branching of the third and fourth order, the ultimate masses beginning in some instances (*a*, *a*) to bud out into cysts Fig. 5. Specimen cultivated on moist agar, the cystophore unusually stout, the ultimate masses almost wholly converted into immature cysts. Fig. 6 Specimen grown on straw showing normal habit; the cysts not yet mature.

PLATE XXIII.

Chondromyces crocatus (B & C)

Fig. 7. Optical section of ultimate rod mass from which the rods have for the most part migrated into the immature cysts. Fig. 8. Three ultimate branches of a cystophore, one of them with three mature cysts still *in situ*. Fig 9. Tip of an ultimate branch of a cystophore on which two cysts still *in situ* have germinated to produce secondary cystophores and cysts (*a*, *a*). Fig. 10. Five detached mature cysts showing extremes of size under ordinary conditions Fig. 11. Vegetative rods

Chondromyces aurantiacus (B. & C)

Fig. 12. Young cysts budding from apex of cystophore. (Living material.) Fig. 13 A more advanced stage, a central column of ascending rods surrounded by a gelatinous layer. (Living material.) Fig. 14. Three specimens from dried material one showing terminal rod-mass from which the cysts have not yet begun to bud. Fig. 15. Specimen from dried material showing furcate habit. Fig 16. Mature specimen from dry material in which the cysts show lateral coalescence. Fig. 17. Three mature cysts. Fig. 18. Two cysts kept on moist wood for several weeks, preparing to germinate. Fig. 19. A similar cyst germinating.

Chondromyces lichenicolus n. sp.

Fig. 20. Mature cysts on short cystophores. Fig. 21. Rod masses rising to form cysts. Figs. 22-23. Mature cysts with short cystophores, showing lobulation and coalescence.

PLATE XXIV.

Chondromyces serpens n. sp.

Fig 24. General habit of coalescent cysts.

Chondromyces aurantiacus (B. & C.)

Fig. 25. General appearence of a portion of rod mass growing in fluid agar. Fig. 26. Living rods from active rod-mass. *a*, rod dividing. Fig. 27. Vegetative rods in glycerine (*a*) showing granular contents stained with borax carmin. Fig. 28. Rods isolated in mature crushed cysts.

Myxococcus coralloides n. sp.

Fig. 29. Highly developed spore mass. Fig. 30. Spore mass of a different form more highly magnified. Fig 31. Spore mass rising from rod mass at its base. Fig. 32. Vegetative rods. Fig. 33. Mature spores. *a*, spores in process of formation.

PLATE XXV.

Myxobacter aureus n. sp.

Fig. 34. General habit showing four cysts embedded in gelatinous matrix. Fig. 35. Rods (living) from rising rod-mass. Fig. 36. Rods from cysts crushed at maturity.

Myxococcus rubescens n. sp.

Fig. 37. General appearance of young spore mass viewed from above and surrounded by vegetative rods. Fig. 38. Normal habit of spore mass viewed laterally. Deliquescence beginning at the top. Fig 39. Vegetative rods. Fig. 40. Different stages of supposed spore formation Fig 41. Mature spores.

Development of the flower and embryo-sac in Aster and Solidago.

G. W. MARTIN.

(WITH PLATES XIX AND XX.)

Concluded from page 358.

Let us now turn to the development of the ovule and the embryo-sac. A short time before the floral organs attain their maximum length, there appears at the bottom of the ovarian cavity a rounded excrescence; this is the incipient ovule, the promise of a future seed (fig. 11).[6] This incipient ovule does not arise from the bottom of the ovarian cavity, but a little above the lowest point. Therefore, the ovule is not the terminal structure on the floral axis. For, by careful focusing, the apex of the fascicular system is seen to end very abruptly at the bottom of the ovary cell. To the right and left of the axial bundle of the pedicel, a little below the apex, are given off fibro-vascular bundles which traverse both sides of the carpellary leaf. It is in the region of one of these lateral bundles, beneath the epidermis, that the primitive cells develop, which arch upward and give rise to the funiculus and the nuclear ovule. Subsequently, a branch of this lateral bundle

---

[6] The ovule somewhat advanced.

enters the funiculus. According to the investigations of Sachs and others, made upon the Compositæ, we have the assertion that the nuclear ovule is a lateral out-growth of the funiculus, but this statement could not satisfactorily be verified by my study of the two genera under investigation. As to the question whether the ovule is a lateral outgrowth on the flower axis there can be no doubt.

So far as could be determined no trace of evidence showed the ovule to be a direct outgrowth on the axis, but on the other hand, an outgrowth on the leaf. Returning again to the early growth of the ovule, as before stated, that it first appears as a rounded excrescence surmounting the funiculus. At first the ovule consists of a mass of cells, the tissue of which is soft and cellular, and is designated the nucleus of the ovule or the nucellus. By further development a large nucleated cell appears within this nucellar tissue, which soon divides, the apical cell of which becomes the mother-cell of the embryo-sac (fig. 12a). In its early development the nucellar body is almost orthotropous, but by further growth it becomes curved (caused by a stronger growth on one side) at the point (base of the nucellus, where the integument originates (fig. 12 b)[7]. At first the integument appears as an annular ring; as growth takes place it forms a complete wall around the nucellus; as the wall encroaches upon the apical portion of the nucellus, the latter becomes more and more curved, but does not seem to be wholly inverted till the integument completely surmounts it, even passing far beyond the nucellar apex (fig. 16). Thus, we have an ovule which is anatropous; having a single integument, though very thick and forming the greater mass of the ovule before fertilization is accomplished, investing a small central portion, the nucellus (fig. 13a)[8]; and the latter, which consists of but one layer of cells, in turn surrounds a more central portion, the embryo-sac (fig. 13b). Originally, this sac consists of but a single nucleated-cell, which, when division is complete, forms a central row of four cells (fig. 16). The nucellus in process of growth becomes very much elongated; its cells are well defined and nucleated; likewise the mother-cell of the embryo-sac, though primitive-

[7] Advanced stages of the ovule

[8] At this point it may be stated that the integument does not develop on the side next the funiculus; this is common with anatropous ovules.

ly polyhedral in outline, but later more oval in contour, elongates and contains a nucleus with nucleolus imbedded in a rich mass of protoplasm. In some sections the nucleus appeared to be elongated in the same direction as that of the embryo-sac. During the subsequent growth of the integument and nucellus the embryonal sac enlarges (figs. 13 and 14), and the nucleus of the mother-cell undergoes subdivision. In fig. 15 the nucleus has divided, and the mother-cell is now separated into two equal parts by a transverse wall, each part containing a nucleated-cell. Presently, the two nuclei divide, a transverse wall is formed in each half, and thus we have, at the end of the second and last subdivision of the mother-cell of the embryo-sac, four equal nucleated-cells (fig. 16). At this stage of the embryo-sac there is a very close analogy to the division of the mother-cell into four cells, worked out by Strasburger in Polygonum and Senecio. The cross walls formed between the cells are very strongly refractive and much swollen; the middle transverse wall is remarkably distended and persists much longer than the other two partitions; in several sections the middle wall was found intact when the coutents of the cells were completely absorbed.

Of the four cells into which the primitive mother-cell of the embryonal sac is now divided, only the lower one is characterized by further growth;[9] this cell, therefore, becomes the true mother-cell of the embryo-sac (fig. 17, *a*). Subsequently, the protoplasm of the upper three cells becomes viscid, the nuclei show disintegration, and the upper wall of the lower, club-shaped cell (mother-cell) indicates a rigid turgescence. When the upper three cells begin to disorganize (in centrifugal order), they become crescent-shaped; their nuclei disappear, their walls are displaced, and the cell contents are absorbed by the encroachment of the lower, mother-cell. After the cells are completely disorganized and absorbed, the mother-cell assumes a central position in the embryo-sac (fig. 18). Simultaneously with the obliteration of the upper cells of the embryo-sac, the one-cell-layer of the nucellus undergoes a similar process of disintegration. The first mark of displacement is shown by the reduction of the cell contents to a granular protoplasmic mass; then follows the disappearance

[9] The micropylar end is known as the upper extremity of the ovule, while its opposite is the lower end.

of the transverse cell walls (fig. 18). The order of nucellar displacement begins at the apical end of the nucellus and proceeds toward its basal portion (fig. 19); finally, the whole nucellar-tissue is displaced and absorbed by the embryo-sac, which subsequently becomes very much enlarged. In fig. 19 is seen a partial obliteration of the nucellus and at this period of growtn the embryo-sac is completely filled with protoplasm, in the central portion of which is located the mother-cell with a vacuole both above and below it. Fig. 20 shows a complete displacement of the nucellus and elongation of the embryo-sac; a farther separation of the vacuoles; the first division of the mother-cell into two daughter cells, each moving, the one into the upper, the other into the lower end of the embryo-sac. In the next stage of development we have the first division of the polar nuclei, thus making two nuclei in each end of the embryo-sac. The two upper nuclei rest within an accumulation of protoplasmic substance, while the two lower nuclei rest within a less dense plasma between an upper and a lower vacuole which show a longitudinal expansion (fig. 21). Previous to the last division of the polar nuclei, a longitudinal increase of the whole embryo-sac takes place. Subsequently, each of the two nuclei divide and we have four nuclei occupying opposite extremities of the embryo-sac. Thus, division is complete, and the upper cells give rise to the egg-apparatus, while the lower are designated antipodal cells. The next stage of development, as in fig. 22, is characterized by the ascent of one of the antipodal cells toward the center of the embryo-sac. This nucleus is imbedded in a dense mass of protoplasmic material separating two large vacuoles. Of the three antipodal cells remaining, the two upper, which lie alongside and impinge on each other, also rest in a plasma bridge separating two vacuoles, the upper of which is the larger and the lower one of the two previously mentioned. The lowermost cell is partly obscured by the impingement of the lowermost vacuole. At the micropylar end of the embryo-sac the cells have a far different significance; one of the cells in its descent toward the center of the sac meets its fellow from below and both coalesce, thus forming a secondary or endosperm nucleus. The three remaining cells, though naked like the three opposite, but surrounded by a denser mass of protoplasm, constitute the true egg-apparatus. The two upper

cells of the egg-apparatus, which lie side by side occupying the whole tapering anterior end of the embryo-sac, are the synergidae; at their lower extremity, extending nearly across the sac, lies a larger rounded cell, the oosphere. In further development, as found in fig. 23, the embryo-sac becomes very much swollen, which is a characteristic feature both before and after the process of fertilization. But fertilization in this case has not yet been accomplished, as the perfectness of outline of the synergidae amply testify. The upper vacuole of the preceding figure shows a contraction toward the upper extremity of the embryonal sac and is more oval in outline. At this stage, also, the upper polar nucleus exhibits retarded action in its descent toward its counterpart from below, in many cases refusing descent till after or about the fertilization period.

To trace the embryonal sac in its further development would result in recounting what, already, is very familiar to many botanists.

Summary.—I. The calyx appears second in order of succession of the floral whorls.

II. The syngenesious anthers seem to be united structurally.

III. The upper polar nucleus shows a slow descent in uniting with the lower one to form the endosperm nucleus.

IV. Compared with Strasburger's study of Senecio the following differences were observed:

(1) The antipodal cells occur in no regular order, and as far as my investigations went, were never found arranged in a single longitudinal row.

(2) No more than four antipodal cells could be discovered, always naked and having no cross walls.

(3) The oosphere, as far as could be determined, failed to occupy the whole diameter of the embryo-sac.

(4) The nuclei of the cells composing the egg-apparatus seemed always to occupy an almost central position.

(5) Vacuoles were seldom seen in the synergidae.

All figures illustrating the development of parts given are from sections supposed to pass through the center of the tissue which they represent.

All material used was fixed in 1 per cent. chromic acid 24 hours, thoroughly washed, stained *in toto* with alum carmine 24 hours, again washed and dehydrated; then taken through

the xylol-absolute-alcohol process into a saturated solution of xylol and paraffine, then infiltrated with paraffine, imbedded, and sectioned with a microtome; again, the sections were counter-stained on the slide with Bismarck brown and mounted in xylol-balsam.

Acknowledgments are due Dr. John M. Coulter and Mr. D. M. Mottier of Indiana University for their valuable suggestions given in the direction of my work.

Indianapolis High School.

A vacation in the Hawaiian islands.

DOUGLAS HOUGHTON CAMPBELL.

As the vacation approached, the question arose, "Where shall I go for the summer?" With the numerous interesting regions within comparatively easy reach of San Francisco, this question was not to be answered without some deliberation; but finally the Hawaiian islands were decided upon, as promising much of interest, both botanical and otherwise.

Hillebrand's Flora of the Hawaiian islands was procured; from it I obtained some idea of what might be expected in the way of vegetation, and with much interest I looked forward to the moment when, for the first time, I should find myself roaming in a tropical forest.

On the 6th of July, behold me, then, a passenger on the Australia, bound for Honolulu. There is very little to record of the voyage, which was pleasant enough but not eventful. One is struck by the paucity of life in the Pacific after getting away from the immediate vicinity of land. None of the giant kelps, so characteristic of the coast region, were seen after the first day out, nor was any floating sea-weed observed during the trip. Animal life was confined to a few sea-birds, mostly "gonies," small brown albatrosses, which followed the ship for several days. As the warmer waters were reached, flying fish became abundant, but they were pretty much the only animals noted on the way over. Not a vessel of any kind was seen after the first day, and the vast stretch of blue water was unbroken by any sign of life. The water is enormously deep, and of a blue so vivid, that one can almost believe that a handkerchief dipped into it would come out blue.

On awakening upon the seventh day out, and looking through the port-hole of my state room, I saw that we were sailing near land. Rugged barren looking hills were seen; and, going upon deck, I learned that this was Oahu, the island upon which Honolulu is situated. As we skirted the shore at a distance, I soon spied a grove of unmistakable cocoa palms, the first hint of the tropical vegetation to which I was soon to be introduced. Beyond was the bold promontory of Diamond Head, an extinct volcanic crater, forming a great bowl with rugged sides, right at the water's edge. Beyond this, and bounded partly by it, is the bay upon whose shores stands the city. Back of it rose abruptly a chain of mountains, in places about three thousand feet above sea-level, and furrowed by deep valleys, whose walls, as well as the cloud-capped summits of the hills, were covered with the most wonderfully verdant vegetation. Never before had I realized the possibilities of green. Blue greens, yellow greens, gray greens, and positive greens, with all degrees of these and others that are indescribable, combined to form what Whistler would term a symphony in green.

As if to vie with the colors of the mountains, the sea exhibited an equally wonderful variety of tints. Outside the harbor is a coral reef, and within this the water is of the pale green common to shallow ocean water; but outside it deepens very rapidly into the vivid blue of the open ocean. From a distance the line is clearly seen; but, as the observer approaches shore, the water changes from deep blue through every shade of blue and green until the pale green of the water within the harbor is reached.

As we approached land numbers of the queer outrigger canoes of the natives were met, and from the wharf boys jumped into the water and swam about the ship in the hope of persuading some of the passengers to throw over to them coins, which they are very skillful in diving for.

On the way to the hotel a few gardens were passed, and in them everything was strange. By far the most striking thing was the superb Poinciana regia. Although I had never seen this before I recognized it in an instant from a description of Charles Kingsley's, read long ago. Surely in the whole vegetable kingdom there is no more splendid plant. A spreading flat-topped tree, perhaps thirty feet high, with feathery green, acacia-like foliage and immense flat clusters of big

flaming scarlet flowers that almost completely hide the leaves so that the tree looks like an immense bouquet. They were in their prime about the time of my arrival in Honolulu and continued to flower more or less for the next six weeks. Pretty much everything in Honolulu, except the cocoanuts and an occasional haw tree (Paritium tiliaceum) is planted; but people seem to vie with each other in seeing how many different kinds of plants they can grow, and the result is that the place is like one great botanical garden. To Dr. Hillebrand this is said to be largely due, as he was one of the first to introduce foreign ornamental plants, and his place, which is kept much as it was at the time he left the islands, was a very remarkable collection of useful and ornamental plants from the warm regions of almost the whole globe.

Probably the first thing that strikes the traveler from the cooler regions is the great variety and number of palms. Of these the beautiful royal palm (Oreodoxa regia) is easily first. With its smooth columnar trunk, looking as if it had been turned, encircled with regular ring-shaped leaf-scars, and its crown of plumy green leaves, it well deserves its name. Other characteristic palms are various species of betel palms (Areca), wine palm, (Caryota), sugar palm (Arenga), and a great variety of fan-palms of different genera. None is more beautiful than a thrifty young cocoa palm, but unfortunately it is very subject in the Hawaiian islands to the ravages of some insect which eats the leaves and often renders them brown and unsightly. Indeed, it is almost impossible to find a specimen which is not more or less disfigured by this pest. The trunk of the cocoanut tree is usually more or less crooked, and in old specimens much too tall for its thickness, so that the old trees look top-heavy. The date palm flourishes in Honolulu, where it is quite dry, but does not do so well in the wetter parts of the islands.

On studying the other trees, one is struck at once by the great preponderance of Leguminosæ, especially Cæsalpineæ and Mimoseæ. All about the town, and growing very rapidly, is the algaroba (Prosopis juliflora), a very graceful tree of rapid growth, with fine bipinnate leaves and sweetish yellow pods, which animals are very fond of, and which are used extensively for fodder. Add to this that the tree now forms the principal supply of fuel for Honolulu and we can realize its full value. Other leguminous trees that are planted are

the monkey-pod (Pithecolobium samang), tamarind, various species of Bauhinia and Cathartocarpus. One species of the latter with great drooping bunches of golden yellow flowers and enormous cylindrical pods three or four feet long, rivals the Poinciana when in full flower.

Mingled with these are a great number of shrubs and trees with showy flowers or leaves, most of them more or less familiar to the stranger, either from pictures or from greenhouse specimens. Several species of Musa are grown, and when sheltered from the wind are most beautiful; but ordinarily the leaves are torn into rags by the wind. The tall and graceful M. sapientium has been largely supplanted by the much less beautiful Chinese banana, M. Cavendishii, which is short and stumpy in growth, but enormously prolific. The related traveler's tree (Ravenala Madagascariensis), is a common and striking feature of many Hawaiian gardens. Of the many showy flowering shrubs, the beautiful Hibiscus Rosa-Sinensis is one of the commonest, and is used extensively for hedges. One of the most striking hedges in the city, however, is the famous one at Puna Hou college, which is 500 feet long and composed of night-blooming cereus. I was not fortunate enough to see this when it was in full flower, but I saw a photograph of it when it was estimated that there were about 8,000 flowers at one time.

Of the fruit trees ordinarily grown, the following may be mentioned. The mango is a very handsome tree with dense dark green foliage and masses of yellow and reddish fruit on long hanging stalks. The bread-fruit tree is common, both cultivated and wild, and is a very beautiful tree of moderate size with leaves looking like immense fig-leaves, and the fruit like a large osage orange. I saw no ripe fruit, and so had not an opportunity of testing its quality. Guavas of different varieties are extremely common both wild and cultivated, and the various fruits of the whole citrus tribe grow well. The few specimens of temperate fruits were, for the most part, much inferior to those of the United States. Of the fruits that did not strike my fancy, at least at first, was the alligator pear (Persea gratissima), a big green or purple pear-shaped fruit with an immense single seed. The pulp is somewhat waxy in consistence and very oily. It is eaten as a salad, and very much relished by the islanders, but the taste is acquired. The curious papaya (Carica papaya) is another fruit which did not appeal to my palate. Its big orange fruit, not unlike a

melon in appearance when cut open, has a peculiar "squashy" flavor that suggested its having been kept a day too long.

Many showy climbers are planted, some of which, like Stephanotis, Thunbergia and Allamanda, are superb; but there is one that is particularly obnoxious in color, Bougainvillea, whose magenta floral-bracts are an offense to the eye, forming a cataract of raw color. It looks, as some one observed, as if it had just come from a chemical bath.

As soon as one gets fairly away from the city, it is at once seen that all the luxuriant vegetation is strange. Along the seashore is a plain gradually rising into low hills, both almost destitute of trees, except here and there a few cocoa palms along the shore. Of the strictly littoral plants among the most conspicuous is the curious Ipomœa pes-capræ, with deeply two-cleft leaves and purplish pink flowers. In the fertile lowlands near the sea are the principal cane and rice fields, which with taro are the staple crops. The rice is cultivated entirely by Chinese, near Honolulu; but on the sugar plantations the Japanese are largely employed. To see a Chinese laboriously transplanting little handfuls of rice into straight rows, or plowing in the mud and water with a primitive plow drawn by a queer Chinese buffalo are sights very foreign to an American eye. Sugar cane is eminently productive in the islands, and, hitherto, has proved the main source of revenue; but now the Hawaiians are bewailing the depression caused by the free admission of sugar from other countries into the United States; as, hitherto, their product has enjoyed practically a monopoly of the American market, having been admitted by treaty free of duty.

I made several trips up the valleys back of the city, but owing to the almost constant rain in many of them, these were not always agreeable. However, one is richly repaid by the luxuriance and variety of the vegetation. For a mile or two we pass between grass-covered hills, or hills overgrown in places with the lantana, which, introduced as an ornamental plant, has become a great pest. This plant covers some of the hills with an absolutely impassable thicket and spreads very rapidly, so that it is a serious problem what is to be done with it. Of the common roadside plants, an orange and yellow milk-weed and the showy white Argemone Mexicana were the most conspicuous. As one proceeds farther, where more moisture prevails, the variety becomes larger. Thickets of Canna and a Clerodendron with double rosy-white flowers,

are common, and the curious screw-pine (Pandanus odoratissimus) is occasionally seen. This latter is a very characteristic plant, but is much more abundant in some of the other islands. In this region several very showy species of Ipomœa are very common, among them the well-known moon-flower, I. bona-nox.

With the increase in moisture, as might be expected, the mosses and ferns increase in number and beauty. There are many of them of types quite different from those of the United States. One of the commonest ferns of the lower elevations is Microlepia tenuifolia, a very graceful fern with finely divided leaves and terminal sori. Species of Vittaria, with very long undivided leaves, are also common here.

As we ascend one of the commonest ferns is Sadleria cyatheoides, a very large fern, often more or less arborescent. Ascending still higher the number and variety of ferns increases rapidly, and many beautiful and interesting ferns and mosses aud liverworts become common.

At about one thousand feet elevation we begin to meet with species of Cibotium, to which genus belong the largest of the tree ferns of the islands. Here, also, I met for the first time with the smallest of all the ferns I have ever seen, Trichomanes pusillum. This dainty little fern, one of the Hymenophyllaceæ, forms dense mats on rocks and tree-trunks, looking like a delicate moss. The full grown frond is fan-shaped and, with its stalk, is not more than half an inch high. These tiny leaves, nevertheless, in many cases bore sporangia.

With the increase in the amount of moisture, the epiphytic ferns become frequent. The principal ones we notice are species of Acrostichum, Polypodium, and, most conspicuous of all, the beautiful bird's-nest fern (Asplenium nidus), with immense bright green entire leaves. This superb plant is not at all uncommon in the forks of trees in the lower forest region.

Everywhere in this region are thickets of Freycinetia, sometimes even climbing the trees. This plant, looking very much like a Pandanus, is troublesome to get through, and often have we found ourselves walking on the tops of the bushes, three or four feet above the ground. As frequent tough convolvuli and ipomœas kept entangling our legs, progress was rather slow.

(*To be concluded.*)

Leland Stanford Junior University.

BRIEFER ARTICLES.

Carl Moritz Gottsche.—Carl Moritz Gottsche, who died Sept. 28th, at Altona, near Hamburg, was born there July 3, 1808. He has been a practicing physician in his native village for over a half century, and during an equal period, an ardent student of the Hepaticae, issuing a large number of publications thereon which vary from a few pages of critical notes to elaborate monographs. From his first serious publications in 1843–5[1] down to his work in recent years there cannot be said to be a single careless issue from his hand. In order to more satisfactorily illustrate his papers, he early learned the art of the engraver and his success in this direction can best be seen in his papers, especially in the matchless plates of his *Mexikanske Levermosser.*

His botanical interest commenced with the group he continued to study. In fact his contributions to other botanical fields are scarcely worth mentioning in comparison. His first papers were chiefly morphological and dealt on the one hand with that curious link between the thallose and foliose Hepaticæ, *Haplomitrium Hookeri,* and the equally curious but scarcely circumscribed marsupiocarpous Hepaticae which he called "Jungermanniae Geocalyceae." In 1844–1847 appeared the Synopsis Hepaticarum which was the combined work of Gottsche and two older men, Lindenberg and Nees von Esenbeck. Although the former had published a monograph of the European species as early as 1829[2] followed by the more elaborate one by the latter in 1833–38,[3] Gottsche's name appears first on the title page and it is evident that he did a large part of the work. This work contains descriptions of over 1600 species of Hepaticae and is the last summary of the group that has appeared, although the number of known species has more than doubled. He was further associated with Lindenberg in the publication of Species Hepaticarum (1839–51), an elaborate work attempting to illustrate all the known species, which for lack of support stopped short with the genera Plagiochila, Lepidozia and Mastigobryum [Bazzania]. In 1856 he became associated with Rabenhorst in issuing exsiccatæ of European Hepaticæ (Hepaticæ Europeæ) which extended to 66 decades (nos. 1–660), and which owe their chief value to Gottsche's elaborate notes and icones which appear on the labels to the specimens. It is unfortunate that the numbered specimens of this series were often carelessly put up and sometimes badly mixed; while

[1] Anatomisch-physiologische Untersuchungen über Haplomitrium Hookeri (1843). Ueber die Fructification der Jungermanniæ Geocalyceæ: (1845). Both papers were published in Acta Acad. Caes.-Leop.

[2] Synopsis Hepaticarum Europaearum. 4to. Bonn, 1829.

[3] Naturgeschichte der europäischen Lebermoose. 4 vols, 12°., Berlin and Breslau, 1833–38.

this was in no way the fault of Gottsche, it detracts from the value of his notes not to have with them, in each case, samples of the same plant on which the notes were made.

While we have not space here to mention all of Gottsche's work we must call attention to two of his papers that are of special interest to Americans. The first is on the Hepaticæ of the U. S. of Columbia[5] and the second is on Hepaticæ of Mexico[6] and more especially bears on our own flora. Both are elaborate works, both are elegantly illustrated by Gottsche's own hand, in both the flora is very fully represented and the monographs constitute a broad and substantial beginning to any further study of the Hepaticæ of these lands. Unlike so many pioneer works, no time will have to be squandered over two or three line descriptions in order to ascertain what was most likely intended by the describer, for the descriptions are as carefully written as the drawings are elegantly engraved.

Dr. Gottsche leaves an extensive herbarium made all the more valuable by his elaborate sketches of the species which he invariably made in his study of any form. Better than all else he leaves a memory which extends over half a century of friendly help he has freely given to students of the Hepaticæ in all lands.—L. M. U.

An edible lichen not heretofore noted as such.—*Endocarpon miniatum* Schaer. has been collected by me in many states, and is abundant in Tennessee. It has also been sent to me from Japan and Cuba, two widely diverse localities. It inhabits calcareous rocks and may easily be mistaken for *Umbilicaria*, two species of which it resembles. I doubt if any writer has noticed or commended this lichen as an article of diet. But Mr. Minakata, who is a distinguished scholar and naturalist, and who has lately spent two years in the United States in study and travel, informs me that large quantities are collected in the mountains of Japan for culinary purposes, and largely exported to China as an article of luxury. He expresses surprise that no attention is paid to it here. The name by which it is known in Japan is *iwataka*, meaning "*stone-mushroom.*" Properly treated it resembles tripe.—W. W. CALKINS, *Chicago, Ill.*

A new Tabebuia from Mexico and Central America: Tabebuia Donnell-Smithii n. sp., PLATE XXVI.—A tree 50 to 75 feet high, often 4 feet in diameter: leaves palmately-compound on long peduncles 5 to 10

[4] As we are so soon to publish a full bibliography of the Hepaticæ, a complete list of Dr. Gottsche's writings will there be given.

[5] Hepaticæ in Triana et Planchon: Prodromus Floræ Novo-Granatensis. Ann. des Sc. Nat., 5th ser., I. 95–198, t XVII–XX (1864).

[6] De Mexikanske Levermosser, efter Prof. Fr. Liebmann's Samling. Dansk. Vid. Salsk. Skrift. VI, 97–380, t. I–XX (1867).

C E Faxon del.

B   se   t B ston

TABEBUIA DONNELL-SMITHII ROSE

inches long; leaflets 7, very variable in size (the largest on petiolues 1 to 3½ inches long), oblong to ovate, acuminate, rounded or truncate at base, serrate, glabrate in age, 2 to 10 inches long, often 3 inches broad: flowers arranged in a large terminal panicle of small cymes, 8 inches long, with short glandular-pubescence throughout: cymes few-flowered, with deciduous scarious bracts; pedicels 6 lines long: calyx closed in bud, deeply cleft and two-lipped in flower, 6 lines long: corolla yellow, tubular, 5-lobed; tube 1 to 1½ inches long; limb 1½ inches broad: stamens 4, included, didynamous; filaments incurved, glabrous except at base; anther cells glabrous, oblong; sterile filament 1½ lines long: ovary sessile: pods 12 inches or more long, 10-ribbed, glandular-pubescent and loculicidally dehiscent: seeds in 2 rows.—Common on the mountains about Colima and cultivated about the town. Collected by Capt. John Donnell Smith, at Cuyuta in the Department of Escuintla, at an alt. of 200 feet, April, 1890, no. 2070; and, also, by Dr. Edward Palmer, at Colima, Jan. 9 to Feb. 6, 1891, no. 1098.

This is said to be one of the most beautiful trees of Mexico, and is called "primavera." The flowers are a beautiful golden yellow produced in great abundance, and generally appearing before the leaves. The trees are often large, sometimes 4 feet in diameter and the wood very valuable. The trees are cut into logs about 12 feet in length, and shipped from Manzanillo in the state of Colima to the United States, principally to Cincinnati and San Francisco where they are used a great deal for cabinet work and veneering. The tree is very common in the lower part of the Department Escuintla; it is tall and slender, usually leafless, and with the profuse delicate yellow flowers standing out against the sky like golden clouds.

The following note is from a letter of J. D. Smith, Jan. 7, 1892: "The trees were too branchless for my servant to climb, too stout for him to fell with his machete, and too high for me to discern what manner of leaves were those which occasionally showed themselves among the flowers. My flowers were all picked up on the ground. I think there must be many trees in those countries, of which botanists have not been able easily to collect specimens, and which, therefore, remain unknown."

I have not been able to place in any known species this interesting tree. It seems curious that a tree so widely distributed, of such attractive flowers and of some commercial importance should have remained unknown to botanists. The species, while not agreeing in all respects with *Tabebuia*, answers better to this than to any other known genus. In its inflorescence and ribbed pods it is more like *Godmannia* or *Cybistax*, but does not agree in other particulars.—J. N. ROSE, *Dep't of Agriculture, Washington, D. C.*

The occasional cross.—When in 1876 I addressed the meeting of the American Association for the Advancement of Science at Detroit,[1] taking for my text what I then regarded as an extravagance, the exact language of a great teacher in science: "All plants with conspicuously colored flowers, or powerful odors, or honeyed secretions, are fertilized by insects; all with inconspicuous flowers, and especially such as have pendulous anthers, or incoherent pollen, are fertilized by the wind" I did not expect to see the proposition so widely modified as it is to-day. Our great leader, Asa Gray, wrote to me reiterating the strength of the position I was combating, and in the curt way quite allowable in the correspondence of friends whose regard for each other no difference of opinion could weaken, "dared" me to produce an instance of a flower as above characterized, that was not arranged for cross-fertilization. It was chiefly this "daring" that has led me in recent years to produce the instances. The broad view soon became modified so as to read that the plants were so arranged as to pollinate themselves in many instances when insects failed to do the work, and I doubt very much whether there is a prominent botanist to-day, who will deny that there are numerous instances in which sweet and colored flowers are so arranged that cross-fertilization is next to impossible. Indeed it has come to be quite frequent for authors on the relations between flowers and insects, when noting the contradictive facts to simply observe that an "occasional cross is not improbable."

It may not be useless at this stage of the progress of thought to inquire, what is the physiological value of an "occasional cross"?

No one familiar with nature can fail to see that, of the millions of seeds annnally produced by plants, an almost imperceptible fraction only come to seed bearing individuals, and the seeds from the "occasional cross" can scarcely have any record in the progressive history of the race. Suppose we take Mr. Robertson's illustration of *Mollugo verticillata* (p. 274). I am satisfied that the "occasional cross" never occurs, and that "spontaneous self-pollination may take place" is putting the case with gratuitous mildness. A microscope would show that not only are the pollen-sacs disrupted and the pollen discharged over the pistil before the flower opens; but so long that the ovarium has commenced to assume the brown tint of ripeness, and the seeds, with full cotyledons, have reached their full size. But suppose this not to be the case, what chance has an "occasional cross" to get the resultant seeds into the reproductive stage again? I have before me a single plant of less than average size. It is one-sided, and extends over half a circle with a twelve inch radius. I find in one seed vessel just 30

[1] See Proc. Am. Ass. XXIV. p. 224.

seeds, and there have been already matured or on the road to maturity 372 seed vessels, with 11,160 seeds. How many of these would get through the long chapter of accidents and produce flowering plants next year? I venture to say not a hundred—possibly not ten. What chance has an "occasional cross" to benefit the race in a scheme like that proposed?

And then we find that those which get more than an "occasional cross" do not get along any better for it. Take Mr. Robertson's illustrations again. *Gaura biennis* I believe to be more dependent on insect aid than he himself has discovered, though none of those he names have any hand whatever in it, while its close ally *Gaura parviflora* is just as absolute a self fertilizer. And if *Œnothera fruticosa* is so arranged that self-pollination is impossible—a fact of which I am by no means sure—how about its neighbor *Œnothera biennis*, which is one of the closest self-fertilizers in the whole family, and yet has made its way not only all over the American continent, but has invaded the old world as well!

I repeat, where does the physiological advantage of the "occasional cross" come in?—THOMAS MEEHAN, *Germantown, Philadelphia.*

Sullivantia Hapemani.—In the November GAZETTE (p. 348), owing to undue haste in printing, this species appeared as a *Heuchera*. The oversight was unfortunate, but it is to be hoped that the correction can overtake the blunder. It is a matter of some interest to discover in our flora a third species of *Sullivantia*, and that, too, with range intermediate between that of the other two. *S. Ohionis* of the north central states (Ohio to Iowa and Minnesota) has always been considered a rare and interesting plant; and *S. Oregana* of the Willamette and Columbia Rivers still more so. This third species, from the Big Horn Mountains of Wyoming, well preserves the generic appearance, and would be recognized at a glance by those familiar with the other species, although much more closely related to its eastern congener, a thing to be expected. All three species affect the same situation; all being found growing in the crevices of dripping cliffs. In addition to the description in the November GAZETTE it may be added that the calyx-lobes are 3-nerved and bright green; the petals are obovate, entire, and brown at base; and the pod is broad and depressed at the partition. The species somewhat resembles *S. Ohionis*, but its lower habit, smaller and deeply cut leaves (the lobes acutely dentate), green and 3-nerved calyx-lobes, much broader obovate (not oblanceolate acutish) petals, and its broad and depressed pod make it very distinct.—JOHN M. COULTER, *Bloomington, Ind.*

EDITORIAL.

Those who are engaged in investigation cannot but regret the increasing tendency to the establishment by educational institutions of independent publications which are to contain the results of investigations conducted at the institution or by members of its staff. It is getting to be the fashion now for all the larger colleges and universities to undertake the issue of either occasional "bulletins," or "contributions," or "studies." The agricultural experiment stations have the issue of at least four bulletins in the course of the year forced upon them by an absurd law; but these newer publications are not stimulated by any thing except the desire of the institution to advertise itself. As soon as a college comes to have graduate students, and a faculty with the leisure and ability for original work, it feels that it must follow the example of other colleges, in order to let it be known that such work is in progress. There is no plea whatever that there is any necessity for the establishment of such publications except self-aggrandizement. It is not that worthy papers could not otherwise see the light; it is not that the regular journals and transactions of learned societies are unable or unwilling to care for the flood of manuscripts which might otherwise be poured upon them. Not that; it is solicitude on the part of the University of B—— lest the University of A—— should become greater in reputation, or should attract more students.

To one who is looking up the literature of any particular subject this multiplicity of irregular journals and bulletins and contributions and proceedings is simply maddening. In Germany this evil has become so great that almost every department of learning is compelled to have its *Jahresbericht* and *Centralblatt*, which have not only attempted to compass German but also all literature in their special fields. But the task is becoming herculean, and sooner or later subdivision either of territory or topic must be made. We are coming to a time, and that rapidly, when such indexes to American literature will be indispensable. Every new and especially every occasional publication adds to the difficulty of collecting or keeping informed of botanical literature. It was therefore with especial pleasure that we welcomed the beginnings of such indexing in the publications of the botanical division and the division of vegetable pathology at Washington.

The objection to the multiplication of publications is the stronger when it is seen that the benefit of advertising can be secured without the evil complained of. The plan long pursued by Drs. Gray and Watson of the Harvard Botanic Garden, and adopted by the Crypto-

gamic Laboratory of the same university, and by the Herbarium of Columbia College is warmly to be commended. The series of papers emanating from these places bears a uniform title and each paper its serial number and sub-title, of which the first article in this issue is an example. By this plan any institution which desires advertising can secure it and at the same time utilize the ordinary channels for obtaining publicity for its investigations.

Or the plan adopted by the Johns-Hopkins University in the publications of its "circulars," and the similar one lately put into operation by the University of Minnesota in its "Quarterly Bulletin" are even more to be commended. In these there appear abstracts of any papers published by students or members of the faculty, with references to the place of publication. They also give opportunity for the inclusion of accounts of university organization and work, and many items of interest to alumni and educators. They thus serve admirably to show what the institutions are doing, and as advertising media could not be improved; while at the same time, instead of adding to the scattered publications which must be kept track of, they actually help to direct the student to the literature he seeks

By all means let the botanists of our larger institutions endeavor to prevent so far as possible the troublesome scattering of botanical papers.

CURRENT LITERATURE.

Western Grasses.

The "Grasses of the Southwest", lately completed, put into the hands of agrostologists 100 plates illustrating the chief species of the arid regions of the south western United States. It is quickly followed by part 1 of the "Grasses of the Pacific Slope",[1] in which fifty of the larger and economically important species are figured. The second part is expected to follow soon and when completed this will be the second volume of the "Illustrations of North American Grasses." Most of the species figured have not been illustrated before. The plates of this part are a decided improvement upon those of the second part of the first vo lume, even as these were better than the first. They are

[1] VASEY, GEORGE—Grasses of the Pacific Slope, including Alaska and the adjacent islands. Plates and descriptions of the grasses of California, Oregon, Washington and the northwestern coast including Alaska. Bulletin 13, Div. of Bot., Dep't of Agric Issued Oct 20, 1892. Imp. 8° pl. 50. Washington. Gov't Printing Office.

lithographs by Meisel, who undoubtedly does the best work in this line of any man in the country.

The descriptions are drawn up mostly by Mr. L. H. Dewey, an assistant botanist of the division.

We have much commendation for the work, and but two adverse criticisms. It is a pity that a fuller synonymy is not given, with critical notes. The plates are valuable indeed; but their value would be much enhanced by such study, with in some cases more minute and thorough dissection of flowers. However if we cannot have a whole loaf we ought to give thanks for the half.

The second criticism relates to purely mechanical details. The plates of the second part of the first volume were nearly ruined by close trimming and these are cut too close also. Why not leave edges uncut, so that one trimming when bound would suffice? Such plates deserve a broad margin, rather than a "skimpy" one.

A new publication.

The botanical laboratory of the University of Pennsylvania begins a new serial entitled "Contributions from the botanical laboratory of the University of Pennsylvania."[1] Several similar publications having come to our attention recently, together with propositions for the establishment of others, we are moved to give expression to our views in the editorial pages on the general advisability of such issues by educational institutions.

This first number is admirably got up. The typography and paper is excellent and the plates are good.

The longest paper is by Dr. Macfarlane on Dionæa muscipula and is directed to a study of the irritability of the leaves. This is followed by a short paper on bud propagation in Dionæa, which Mr. Harshberger found to occur occasionally in the inflorescence. There are two papers by Dr. Wilson, one on the dioecism and proportion of staminate and pistillate flowers in Epigæa repens; the other (with the assistance of Mr. Greenman) on the movements of the leaves of Melilotus alba and other plants. In these researches Dr. Wilson finds that Melilotus and many other plants have a "hot sun" position for their leaves which is dependent largely upon the heat rays and the water supply, since it is intended to protect plants from excessive evaporation. Dr. Rothrock has two short notes, one on a monstrous form of Rudbeckia hirta, and the other on a nascent variety of Brunella vulgaris. Finally there is a chemical paper on mangrove bark tannin by Dr. Trimble, who finds this tannin quite similar to that in horse-chestnut, tormentil and rhatany.

[1]Philadelphia: Univ. of Pa. Press. 1892. vol. 1. no. 1. 8vo, pp. 73, pl. 13.

Minor notices.

THE SECOND BULLETIN of the U. S. Division of Vegetable Pathology[1] is devoted to a detailed preliminary report upon the California vine disease, which appeared in sufficient amount to attract attention in 1884 and 1885. Since then its spread has been rapid until 20,000 to 25,000 acres of vineyards in S. California have been devastated. The cause of the disease has not yet been discovered. This report gives an account of the incubation and spread of the disease; its characteristics and its relation to various supposed causes. It seems most nearly reated to *rougeot* and *folletage*.

PROFESSOR L. H. PAMMEL has distributed copies of an elaborately illustrated lecture on the "Pollination of Flowers"[2] delivered at the January meeting of the Iowa Horticultural Society. The collation of useful illustrations (though these are wretchedly printed) and the most important literature bearing on this subject makes the pamphlet a very useful one to teachers. Two other short papers, "Cross and self-fertilization in plants" and "The effects of cross-fertilization in plants" are also included in the pamphlet.

OPEN LETTERS.

The Botanical Congress.

Since opinions are asked regarding an American Botanical Congress at Madison next year, I give mine briefly and categorically as follows:

1. By all means we must have a congress. Foreign botanists are expecting it, the time is ripe for it, and properly arranged, I believe that we will be able to secure a large and representative foreign delegation.
2. The success of the congress will depend *very largely* on the selection of a *live* general manager or secretary who will not be trammelled in his action by too much *a priori* machinery. He must be given power to act, if necessary, promptly *because* independently.
3. Action should be taken at once to secure a meeting of the International Committee on Nomenclature appointed at Genoa, in connection with next year's congress.
4. A program containing a *few* topics of general interest to botanists throughout the world should be announced at an early date. Now that nomenclature is practically settled, we are in a position to appreciate the fact that there are other matters of more importance, some of which may well be discussed in such a presence.

---

[1] Washington: Gov. Printing Office: 1892. 8°. pp. 222. pl. xxv. chart 2.

[2] Apparently privately printed. pp. 57. figs 45.

5. The date should be pushed to the very last of August or the first week in September in order to accommodate European botanists whose university duties would prevent attendance earlier.

6. A free excursion of reasonable length (say as far as Lake Superior) ought to be arranged for; to this, arrangements should be added whereby foreign delegates could secure special rates to our great attractions in the far west should they care to make such extended excursions.—LUCIEN M. UNDERWOOD, *Greencastle, Ind.*

NEWS AND NOTES.

MR. W. H. NORRIS describes in the *American Naturalist* for August the development of the ovule of *Grindelia squarrosa.*

MR. D. T. MACDOUGAL is arranging a collecting trip to Mexico. He will start early in January. Those desiring plants from this region can address him regarding the matter at LaFayette, Ind.

A NEW EDITION of Koch's "Synopsis Floræ Germaniæ" is to be published under the editorship of Prof. P. Ascherson. The Prussian Academy of Sciences has voted him 2,000 marks to carry on the work.

THE BOTANICAL DEPARTMENT in the Bohemian University at Prague has been strengthened by the appointment of Dr. A. Hansgirg, until now lecturer in the same institution, and Dr. R. von Wettstein, of Vienna, to professorships.

MR. F. V. COVILLE gives an interesting account of the Panamint Indians of California (Am. Anthrop. v. 351), in which there is much of botanical interest. The question as to what these desert Indians can find in the way of vegetable food is answered by a surprisingly long list of plants whose seeds are chiefly used.

IN THE LAST number of *Hedwigia* (heft 4, 1892) Dr. C. Warnstorf describes five new species of Sphagnum: *S. Labradorense* of the ACUTIFOLIA, from Labrador; *S. dasyphyllum* of the CUSPIDATA from Connecticut; *S. Orlandense* from Florida; *S. Mohrianum* and *S. Mobilense* from Alabama, the three latter of the SUBSECUNDA.

M. HENRY DOULIOT, preparator at the Museum of Natural History at Paris, is dead at the age of 38, from a disease contracted during a scientific expedition. M. Douliot had already aquired a wide reputation through his researches in the histology of the higher plants. His work has been largely in conjunction with M. Van Tieghem.

IN THE November GAZETTE, (p. 341) we inadvertently omitted mention of the fact that the Department of Agriculture was the body that Dr. Vasey represented at Genoa, in addition to the Smithsonian Institute. It is but just that this correction should be made since the Department was the financial authority for the mission.—L. M. UNDERWOOD.

AMONG THE REPORTS of the large scientific staff at work on the Government Experiment Farms at Ottawa, Canada, for 1891, just issued as an appendix to the report of the Minister of Agriculture, is one from Mr. James Fletcher, the Botanist. It is concerned chiefly with reporting concerning experiments with grasses, some of which are figured, and describing some of the most prevalent and dangerous weeds that Canadian farmers will be likely to encounter.

THE TECHNIQUE of celloidin inbedding will be found set forth *in extenso* in two recent articles; one by W. Busse in *Zeitschrift für wissenschaftliche Mikroskopie* VIII. 462–475; and the other in a series entitled Mikrotechnische Mittheilungen, by Ludwig Koch, of which the first installment appears in Pringsheim's *Jahrbücher für wissenschaftliche Botanik*, XXIV. 1–51, under the caption "Ueber Einbettung, Einschluss und Färben pflanzlicher Objecte."

A LIST of Ohio Uredineæ and a brief account of wheat scab, by Miss Freda Detmers, together with a short description of Lactuca Scariola, by C. E. Thorne, make up bulletin 44 of the Ohio Experiment Station. The list of rusts contains about 68 species. The hosts and localities are given, and also a few additional notes. There is evidence of a lack of careful proof reading, and the cuts illustrating Lactuca and wheat scab are wretchedly printed.

AN IMPORTANT monograph of one of the much neglected groups of lower plants, the Oscillarieæ, appears in the *Annales des Sciences Naturelles* VII, XV, p. 263–368, with five plates. This, with the earlier monograph of the heterocystic Nostocaceæ by Bornet and Flahault, gives tolerably complete facilities for the determination of these plants. If some one would now put into compact form an account of our American species with analytic keys it would be serviceable.

DR. BYRON D. HALSTED is soon to issue a century of weed-seeds. The seeds will be in convenient vials, held in a tray which is about the size of an herbarium sheet. Suitable printed labels are also distributed. This collection is designed to assist station botanists in determining the foul stuff in commercial seeds, and also for the use of seedsmen; but all botanists should be interested. The price per set is $10, which is far below the real cost, and Dr. Halsted may be addressed at the N. J. Experiment Station, New Brunswick, N. J.

MR. ERNEST WALKER, of New Albany, Ind., has made some interesting observations on the scattering of seeds by the pods of *Oxalis stricta*. In the proper condition, the least disturbance will cause the seeds to be expelled with considerable force, and thrown two or three feet. Mr. Walker finds that the outer seed-coat is the agent in this dissemination, being a translucent shining membranous envelope stretched tightly over the seed, suddenly and elestically turning inside out when it bursts. Further details can be had from Proc. Philad. Acad., 1892, p. 288.

THREE DISEASES of tomatoes grown under glass are described by Prof. L. H. Bailey (Bull. no. 43), as observed at the Cornell Experiment Station. The most serious one, called winter blight, appears to be of a bacterial nature. Growth is checked, the leaves show ill-defined yellowish spots, later turning dark, the leaf curls and becomes stiff, the edges drawing downwards, giving the plant a wilted appear-

ance. Common blight (Cladosporium fulvum) and root-galls, caused by nematodes, are also described and illustrated. The results of various preventive measures are given.

IN A CONTRIBUTION to the physiology of collenchyma (Prings. Jahrb. f. wiss. Bot. XXIV. 145) Jonas Cohn finds that this tissue normally contains in the cell wall from 60 to 70 per cent. by weight of water as against 20–40 per cent. in bast and wood. He holds that Bokorny's deductions as to the water-conducting function of collencyhma are founded on inexact experimentation and that C. Müller's idea that this is a water-storing tissue is likewise unsatisfactory. He was unable, however, to discover the relation between the mechanical peculiarities and the watery contents of collenchyma, and therefore does not suggest any theory as to its function.

MR. H. J. WEBBER and Mr. W. T. Swingle are now at Eustis, Lake county, Florida, where a laboratory is being erected and fitted up for conducting experimental work on the anatomy, physiology and pathology of subtropical economic plants. The first important task is to learn something of Citrus fruits. Mr. Swingle has been working on the diseases of Citrus for the last two years. These observers are now starting at the base of matter in the orange blight investigation, and are just starting experiments on the transpiration of healthy and diseased plants, coupled with a histological investigation of the leaf and conducting tissue of healthy and diseased limbs.

THE UNIVERSITY OF ILLINOIS lately completed a new building for the departments of botany, zoology and geology which was formally dedicated as "Natural History Hall" on November 16th.

The exercises included addresses upon the development of the natural history departments, by Professor T. J. Burrill; science and the American college, by President David S. Jordan, of Leland Stanford University; the laboratory as a necessary part of the college equipment, by Professor William Trelease, Director of the Shaw School of Botany; and the methods of geology, by Professor N. H. Winchell, State Geologist of Minnesota. The botanical laboratories are said to be admirably arranged and adapted to the needs of instruction and investigation.

MR. ELLIOTT COUES gives a good illustration in a recent number of *Science* (xx, p. 219) of the proper meaning of the expression "once a synonym, always a synonym," which we reproduce in part. He says: "Let there be a genus *Smithia* in botany. Let a genus *Jonesia* then be named. Let *Jonesia* then be found to be the same genus as *Smithia*. Then the name *Jonesia* 'lapses into synonymy' and can not be thereafter applied *to any other genus* in botany. Exactly the same principle holds for all specific names within their respective genera. Example: Let there be a *Rosa Smithi*. Let some one then name a *Rosa Jonesi*. Let *R. Jonesi* be considered to be the same species as *R. Smithi*. Then there can never be a *R. Jonesi;* that is to say, *no other species* of *Rosa* can be specified as *R. Jonesi*. But, of course, if any one discovers, after this reduction of *Jonesi* to a synonym of *Smithi*, that what had been called *R. Jonesi* is a good species, then *Jonesi* revives as the name of *that* species; and the fact that it had been (erroneously) regarded as a synonym of *Smithi* is no bar to its use in its original sense."

GENERAL INDEX.

*** The more important classified entries will be found under the following heads: *Diseases*, *Floras*, *Journals*, *Personals*, *Reviews*.

*** Names of synonyms are printed in *Italics;* names of new species in **bold-face;** † signifies death

A

B

C

D

E

F

Q

R

S

T

U

V

W

X

Y

INDEX TO AUTHORS.